SNS-102010200-PC0001-R05

Project Controls Manual

November 2002

SNS-102010200-PC0001-R05

PROJECT CONTROLS MANUAL

Date Published: November 2002

Prepared for the
U.S. Department of Energy
Office of Science

University of Tennessee- Batelle
managing the
Spallation Neutron Source Activities at the

Argonne National Laboratory
Brookhaven National Laboratory
Lawrence Berkeley National Laboratory
Los Alamos National Laboratory
Oak Ridge National Laboratory
Thomas Jefferson National Accelerator Facility

under contract DE-AC05-000R22725
for the
U.S. DEPARTMENT OF ENERGY

PROJECT CONTROLS MANUAL

November 2002

CONTENTS

Page

ACRONYMS

ACWP	Actual Cost of Work Performed
AE/CM	Architect Engineer/Construction Manager
APP	Advanced Procurement Plan
APS	Advanced Photon Source
BAC	Budget at Completion
BCP	Baseline Change Proposal
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
CM	construction manager
CMP	Configuration Management Plan
CPR	Cost Performance Report
DCN	Document Change Notice
DOE	U.S. Department of Energy
EAC	Estimate at Completion
EV	Earned Value
HQ	DOE Headquarters
IPS	Integrated Project Schedule
M&S	Materials & Services
MPM	Microframe Program Manager
ML	Milestone Log
MSSR	Milestone Schedule and Status Report
OR	Oak Ridge
ORNL	Oak Ridge National Laboratory
P3	Primavera
PBB	Project Budget Baseline
PCR	Project Change Request
PEP	Project Execution Plan
PMB	Performance Measurement Baseline
RFP	request for proposal
SNS	Spallation Neutron Source
STL	Senior Team Leader
TPC	Total Project Cost
WBS	Work Breakdown Structure

1. BACKGROUND AND INTRODUCTION

1.1 FOUNDATION FOR SNS PROJECT CONTROLS APPROACH

The SNS Project is a complex scientific and organizational undertaking. From the collaborative National Laboratory project organization partnership, to the various scientific details and issues being addressed, the SNS Project represents many unique challenges and opportunities for innovative performance. The SNS Project Execution Plan provides policy guidance for the overall planning and execution approach being utilized on the Project, and invokes this Project Controls Manual as the reference procedure for implementation of all estimating, budgeting, planning, and scheduling activities on the project.

The Project Controls processes, elements, and detailed methodologies defined within the body of this manual and the attached appendices are based on a wide variety of Department of Energy policy and procedural guidance documents and the successful processes and methodologies utilized by other projects, such as the Advanced Photon Source (APS). Also reflected are various implementation practices already in place at the six National Laboratory partners and the architect engineer/constructor for the conventional facilities. In addition, the foundation of the overall Project Controls approach continues to be refined to reflect the recommendations provided to the SNS Project Team as a result of Project Reviews.

The SNS Project Controls philosophy and overall approach focuses on:

- Project Office leadership to ensure common denominator planning and execution
- Organizational responsibility for performance and results by each project participant
- An optimum balance of supporting processes and details
- Efficient reporting and performance measurement
- A clarity of focus on controlling project schedule and cost baseline “drivers”

The SNS Project Controls program will evolve with different areas of emphasis as the project evolves through the various phases of project execution. Earned value measures, lower level schedule milestones, performance indicators, and performance reports and review meetings will be refined to suit the requirements of the project in various phases.

1.2 LESSONS LEARNED ON OTHER PROJECTS THROUGHOUT DOE

In addition to adopting successful practices from projects like the APS, an important ingredient in developing a successful Project Controls Program includes the evaluation and application of lessons learned from unsuccessful projects. The SNS Project Team must be sensitive to the practices and lessons learned on these projects, and establish and use systems that ensure success for the SNS Project in the future.

In the past, projects have failed for various technical and management reasons. As outlined in Appendix D, various references and studies compiled by the DOE and other reviewers document the deficiencies and errors that have formed a pattern for failure on numerous projects in recent years. Several root causes that have led to the failure of project controls programs are summarized below:

- **Inadequate Change Control Processes and Procedures**—This can lead to large scope and schedule changes, and result in large cost increases. Inadequate change control procedures can also preclude the ability to trace the reasons for cost growth from the original baseline. These problems can be greatly reduced by development and strict use of a detailed change control procedure.
- **Inadequate and Inaccurate Project Status Reports**—Project managers must continuously assess and analyze the project status. This has been impossible on some past projects due to the lack of, or improper reports, from contractors and project participants. In addition, some reports have been found to contain inaccurate data, thereby resulting in incorrect analysis and assessment. Identifying early in the planning process what information is needed to assess and analyze the project properly, and requiring that information to be furnished will assist in minimizing this problem.
- **Insufficient Project Reviews**—Both the frequency and the content of project reviews have been inadequate on some past projects. Assuring that project management personnel give the proper emphasis to the review process can minimize this problem.

Establishing and using the Project Controls Program outlined within this manual will avoid these causes of project failure and establish the framework for success.

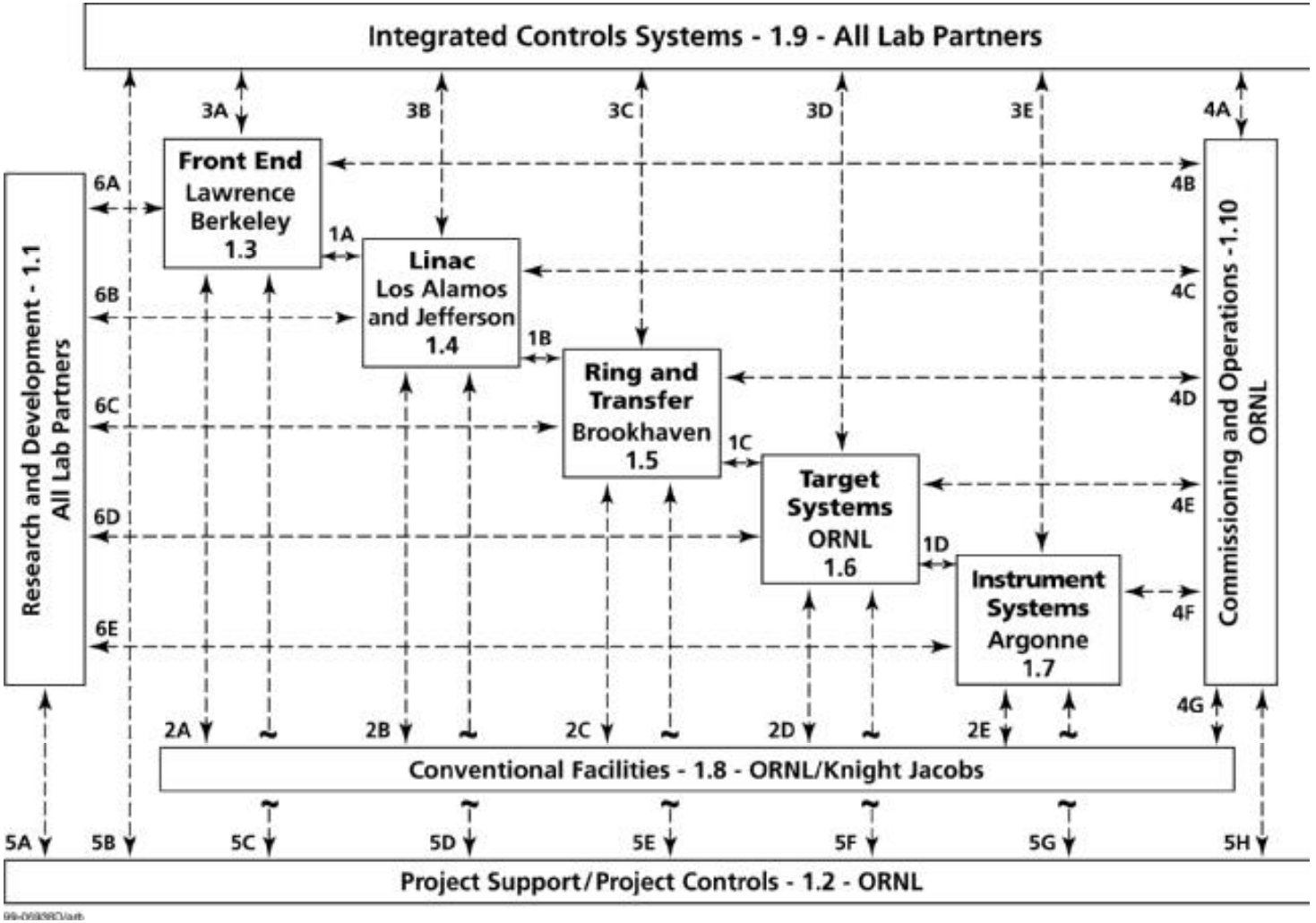
1.3 SNS CHALLENGES

The SNS Project collaboration of six National Laboratory Partners and AE/CM contractor provides a tremendous foundation of technical and management strength, capability, and flexibility to support a successful program. Intrinsic with this strength, however, is also the difficult challenge of managing the technical, cost, and schedule baselines while properly integrating the communication and interface coordination details of seven design and purchasing authorities. Figure 1 provides a summary depiction of the principal SNS technical and management interface relationships at WBS Level 2 that must be managed to assure a comprehensive program is in place to support a successful project. The diagram illustrates the complexity of technical and management interfaces that must be dealt with very systematically to assure that communications are clear.

As depicted with interfaces 5A through 5H, the Project Office Project Controls organization is the focal point to provide the leadership and direction necessary to assure that cost estimate/budget and schedule planning, status reporting, performance measurement, and baseline change control processes and methods are efficient and consistent. Working with Project Management, , the Project Controls Manager will have the authority to assure that a sound basis and process exists across all partner organizations to support effective and timely compiling of project controls information on various reporting frequencies. This will include:

- Periodic sampling validation reviews of partner source information and processes
- Training required to assure a common denominator process is understood and maintained
- Participant feedback to refine the process as the project evolves from one phase to another.

Fig. 1. Principal SNS technical and management interface relationships.



1.4 OBJECTIVES OF THE SNS PROJECT CONTROLS SYSTEM

The SNS Project Controls System is an integrated management control system for project planning, cost/schedule performance measurement, analysis, and reporting. Objectives of the SNS project controls system are to:

- Establish consistent processes to assure that auditable bases exist to support the development of life cycle cost/budget and schedule project baselines
- Provide mechanisms at each laboratory and at the Project Office to objectively identify the status of the project
- Reliably detect actual schedule or cost performance variances from baselines
- Reveal what must be done to recover from variances

These objectives shall be satisfied by developing and using a system that provides:

- An Earned Value (EV) system at each laboratory based on measurable work
- Variance analysis on major items (i.e., critical path or large dollar impacts)
- A Change Control Process
- Organizational accountability for performance/accomplishments.

1.5 DOCUMENT PURPOSE AND ARRANGEMENT OF CONTENTS

This project controls manual details the cost and schedule control systems that have been established to manage the SNS Project. The appendices are intended to be a “handbook” for day-to-day use by those involved in the processes of project management, administration, control and status reporting. Also identified in Appendix D are the documents referenced and considered when developing the Project Controls Manual. It is the policy of the SNS Project Director that all SNS project personnel comply with the requirements and intent of the systems described within this document. By this policy, the Project Director ensures that authorized work is being consistently performed, measured and reported in accordance with DOE criteria.

2. THE PROJECT CONTROL PROCESS OVERVIEW

2.1 ORGANIZATION

The organization for the SNS Project is established in the Project Execution Plan (PEP). The key staff involved in carrying out the daily planning, execution and control of the project controls function are:

- Deputy Project Director
- Management Information Systems (MIS) and Project Controls Manager
- Project Controls Manager
- Project Controls Staff in the Project Office and at each Laboratory partner and the AE/CM contractor
- Baseline Change Control Process Manager
- Business Manager
- Procurement Director
- Division Directors
- Senior Team Leaders (STL)
- AE/CM Project Manager

2.2 FUNCTIONS, RESPONSIBILITIES, AND AUTHORITY

Key positions in the project controls function are the Deputy Project Director and the MIS and Project Controls Manager. The MIS and Project Controls Manager is the focal point for the Deputy Project Director to provide leadership for coordinating overall SNS Project Controls activities. The Project Controls Manager will provide systems and procedures for timely and accurate variance determination. These systems ensure that the processes across all partner organizations support effective and timely compiling of project controls information on various reporting frequencies. This involves close coordination and frequent communications with the Deputy Project Director, Division Directors, Senior Team Leaders, and participant project controls staffs.

The STL's and the AE/CM project manager are responsible for executing the project and for overall performance and results. They will provide timely input to the Project Controls Manager in the format described in the Project Controls Manual. The Business Manager is responsible for Financial Controls (See Appendix G) and portions of the Work Authorization Process described in this document. Management of the procurement process is the responsibility of the Procurement Director (See Appendix H). It must be emphasized that this team, working together, provides the executive leadership of the SNS Project the essential information for the timely and on budget completion of the project. Cooperation and teamwork are fundamental to success of the project controls function.

2.3 PROCESS

The Project Control System's purpose is to effectively control project execution. Goals are established, a plan is prepared, progress is measured and compared with the plan, variances from the plan are analyzed and alternative courses of corrective action evaluated, the best course of action is selected, and the plan is modified accordingly. Trends within each reporting segment are developed and analyzed (See Figure 2). Compliance with work breakdown structure, cost and schedule control and performance reporting provides the necessary assurance that the Deputy Project Director has the basic data required for timely and meaningful management decisions. This system must produce standardized, timely, consistent, and accurate data.

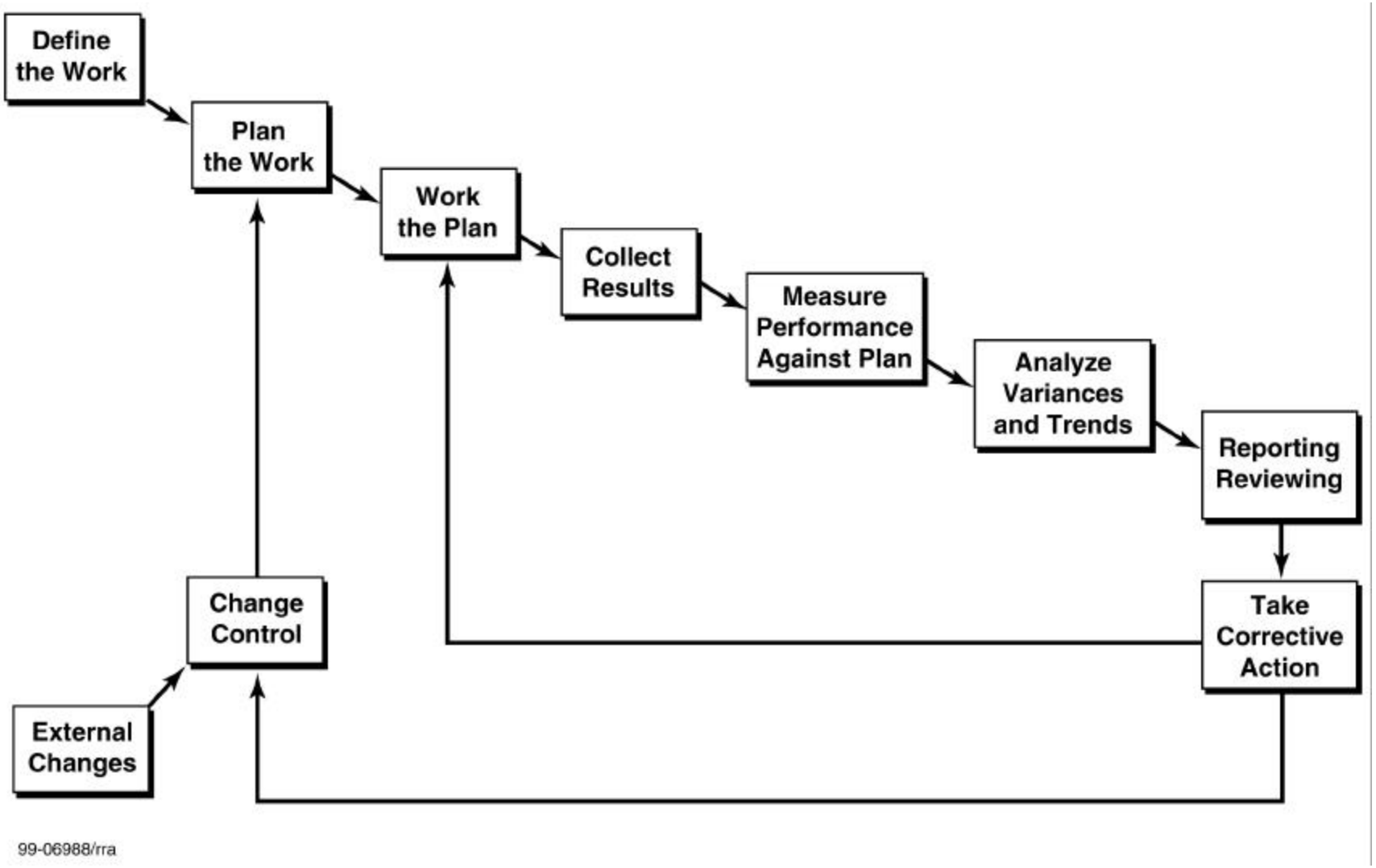


Fig. 2. SNS Project Controls System.

3. PLANNING FOR INTEGRATED ESTIMATING, BUDGETING AND SCHEDULING

The planning and budgeting process for the SNS Project includes the scheduling system and the cost planning system. The Cost Estimate Database (CEDB) was the repository for the basis of estimate for the Project's baselined budget. However, the estimate was moved into Micro-Frame Program Manager (MPM) in March 2001. Each estimate was assigned to a schedule activity and, as such, the estimate in MPM is time phased and appropriately burdened and escalated. As monthly reporting data is available (schedule status, BCWP, and actual costs), it is imported into MPM, completing the final integration of all of the performance measurement components (schedule, performance and actual costs).

3.1 WORK BREAKDOWN STRUCTURE

A Work Breakdown Structure (WBS) has been established for the SNS Project, which identifies all elements of work within a framework that facilitates logical planning, budgeting, scheduling, assignment of responsibilities, cost tracking, performance measurement, and reporting of status. Revisions to the WBS are controlled through the change control process. SNS 102020100BL0002, WBS Descriptors, describes the scope of the WBS elements.

3.2 ESTIMATING AND BUDGET DEVELOPMENT

Objectives during the budgeting process are as follows:

- Integrate the Project budget with the approved scope and schedule;
- Establish a time-phased budget baseline in such a manner to facilitate cost/schedule performance measurement; and
- Maintain the integrity of the time-phased budget baseline.

A budget represents the target cost for a particular scope of work and is based on the allocation of resources to scheduled activities. Integrating the budgeting process with the schedule assures that a Performance Measurement Baseline is properly established and maintained throughout the entire period of performance.

3.2.1 Procedure

The detailed Project cost estimates (and the subsequent estimate prepared with project change request or ETCs), developed and maintained under the guidance of the STLs, are the primary data source in determining budget values. Estimates are prepared at the schedule activity level and in accordance with the requirements and guidelines in Appendix B. These guidelines allow standardization of data formats and estimating methods. Appendix I provides a responsibility matrix. Changes to the project cost baseline will only be through approved change requests.

3.2.1.1 Discrete Effort

Work is planned as discrete (measured effort with a final product) to the maximum extent practicable. Within a current planning year (and as reflected in the funding packages), activities should be of short duration and have definite scheduled start and completion dates. When practical, activities longer than two

to four months in duration should have intermediate milestones that provide interim performance measurement data.

3.2.1.2 Level of Effort

When a task cannot be measured as Discrete, Level of Effort (LOE) planning will be used. Level of Effort represents work that has no discrete measuring points. LOE will be kept to a minimum. LOE activities are measured the same as discrete tasks except that there is never any schedule variance and BCWP always equals BCWS.

3.2.1.3 Other EV Options

Most of the EV options available in the project's cost module, MPM, have been offered to the subprojects for use on their detailed activities. These options are described in Section 6 of this document.

3.2.2 Budget Baselines

3.2.2.1 Performance Measurement Baseline (PMB)

The PMB is the budget against which performance is measured and is developed by the integration of the cost estimate resource data assigned to schedule activities. The PMB resides in MPM, the project's cost baseline. MPM project structure and processes are defined in Appendix K.

MPM was implemented in March 2001 at the detail activity level that compares directly with the detailed schedules. Previously the PMB was maintained through the CEDB and Excel spreadsheets. Changes to the performance measurement baseline occur only through approved Project Change Requests.

3.2.2.2 Project Budget Baseline (PBB)

The PBB is equal to the sum of Contingency and the PMB and is synonymous to Total Project Cost (TPC). Earned value reporting is required for activities funded by operating funds. However, contingency is only available for line item tasks.

3.3 SCHEDULE DEVELOPMENT

The objective of the schedule control system is to ensure that SNS work is effectively planned and scheduled and to provide a mechanism for measuring progress against plans. The system also provides the identification of interface requirements among the partner laboratories. Appendix C provides the scheduling requirements and procedures. Appendix I depicts the roles and responsibilities in schedule development, statusing, analysis and reporting.

3.3.1 Scheduling Hierarchy and Management Milestones

The SNS schedules are "tiered" from the Project Summary Schedule through intermediate schedules to the detail project schedule (which is at the level of greatest detail). The set of project schedules used in managing the SNS project are described in Table 1. These include the Project Summary Schedule, the Integrated Project Schedule (IPS), and detailed project schedules. The documents are similar to that

described in DOE document GPG-FM-01 and their centerpiece is the Integrated Project Schedule (IPS) that shows the strategy for building, testing, and commissioning the facility.

The approved Project baseline is instituted at the Project Summary Schedule and driven down as progressively more detailed schedules are implemented. The detailed subproject schedules were initially baselined at the detail level in January 2001. Changes to this baseline occur only through approved Project Change Requests

The Baseline Milestones in the Summary Schedule, their definitions and planned dates were mutually developed by SNS and the DOE and are documented in the Project Execution Plan (PEP). Level 0, Level 1A, and Level 1B milestones are described in PEP Appendix A, Table A-1, and Level 2 Milestones are described in PEP Appendix B, Section 8.3. The Project Office tracks the status of these milestones. The actual and forecasted status is reported each month by the Senior Team Leader (STL). Schedule status is also provided monthly by the STL. Schedule variances are calculated by comparing these statused dates to the approved baseline dates. Additional milestones at the IPS and activity levels are used to provide visibility of other key events.

Table 1. Project Schedule

Schedule Document	Primary User	Purpose
Project Summary Schedule	DOE Headquarters	Show overall summary-level project baseline schedule; provides template for baseline dates in all lower level schedules; identify all DOE Schedule Milestones
Integrated Project Schedule (IPS)	DOE-ORO and SNS Project Managers	Define project schedule strategy; identify construction and commissioning strategy and critical paths; monitor project wide basis
Detailed Project Schedules	All Project Team Members	Plan and monitor progress of scheduled activities; generate percent complete data; generate reports

The partner laboratories are responsible for maintaining the detailed schedules. The Project Office scheduler is responsible for maintaining the Summary Schedule and the IPS, and overall administration of the scheduling system. This includes horizontal and vertical integration of elements of the scheduling system, monthly critical path analysis of the integrated schedule, maintenance of schedule baselines, reporting baseline schedule status to DOE, and providing enhancements to the scheduling system.

3.3.2 Schedule Implementation

Annual Funding Packages are created from the detailed project schedule and developed by the responsible manager at each subproject. They are approved by the STL and agreed to by Division Director. The funding packages summarize (at level 4, 3 and 2) the resource loaded activities in the detail schedules. These detail schedules are the lowest level schedules in the SNS performance measurement system. Longer, more summary activities represent the remaining out year work. The activities in the

current 12 month window should average 4-6 months in duration with activities longer than two-four months having intermediate milestones to the maximum extent practical. The intent is to have all discrete effort (a measurable final product) planned with frequent and measurable control points. Milestones are represented as zero duration activities and are a part of the logic flow. Any effort that has no definable product or milestones will be planned as Level of Effort (LOE). However, Level of Effort planning will be kept to a minimum. In addition, LOE activities are to be scheduled to end at the end of each fiscal year.

Resources are applied to schedule activities for the purpose of establishing BCWS and BWCP values within MPM. The SNS project office will integrate the subprojects' detailed schedules to provide a vehicle for total project critical path and "what-if" analyses. All technical components and support facilities will be scheduled in detail from design through procurement, installation, and final testing.

Schedules are established and saved electronically utilizing Primavera software. Specific guidelines for schedule development are included in Appendix C. The baseline schedules are under configuration control.

3.3.3 Schedule Maintenance

3.3.3.1 Progress and Status

Schedules are statused monthly at the activity level with input from the responsible manager. Work will only be performed on authorized activities approved with the funding package or a subsequent PCR. Actual start and/or completion dates will be entered against the activities, producing a working schedule. Comparing the working dates to the baseline dates will facilitate variance analysis. Schedule logic will allow the impact of behind schedule activities on downstream events to be reported and summarized and the critical path to be analyzed. The responsible STL will review the schedule status, prior to submitting it to the Project Office on the fifth working day of the next month. Upon receipt of the statused detail schedules (electronic Primavera P3 files), the Project Office will integrate the schedules and analyze for impacts to the inter-project links, project critical path and Level 0-3 milestones.

3.3.3.2 Baseline Revisions

Schedule variances, which exceed pre-established variance thresholds, may be addressed through the change control process if they cannot be brought back in line with the existing baseline. The thresholds and change control process is defined in the Configuration Management Plan, SNS-102010200-PC0002. Once approved, baseline changes will be incorporated into the schedule and future statusing will be compared to the revised baseline.

4. WORK AUTHORIZATION

4.1 PROJECT FUNDING AUTHORIZATION

With the passage of appropriating legislation for the Spallation Neutron Source (SNS) Project, U.S. Department of Energy (DOE) Headquarters (HQ) provides funds to the SNS Project Office through the normal financial plan process and authorization to perform work through the DOE work authorization system. The DOE financial plan provides funds for the operating expense, capital equipment, and line item portions of the project. Actual expenditures and commitments are limited by the amount of funds authorized by DOE and the type of funds made available (operating expense, capital equipment, line item construction). At no time shall cost plus the outstanding commitment balance exceed the funds authorized by DOE.

In anticipation of the receipt of funds and work authorization, agreement will be reached with each laboratory on the work scope, milestones, budgets, and type of funds for the ensuing fiscal year. Each laboratory will transmit funding packages to the Project office for review and acceptance by the Project Director. After acceptance by the appropriate Division Director and the Project Director, the funding packages will become the official work scope for the coming year.

A directive/work authorization will be provided by DOE-Oak Ridge (OR). If a financial plan has not been received by the beginning of the fiscal year, the DOE-OR SNS Project Office will issue directive authorization subject to receipt of the financial plan or availability of funds.

The Business Manager will prepare the necessary documents (i.e., procurement request) to authorize participating laboratories to cost and commit funds. The Finance Officer signs the procurement request after the financial plan, the DOE work authorization document, and the directive authorization are received/approved. The Business Manager then submits the request to the SNS Deputy Project Director for approval. Once approved, the Deputy Project Director processes the request to the SNS procurement office, where the procurement package is prepared and transmitted to DOE-OR. Figure 3 shows the process just described. Official funding authorization will be provided to each laboratory via DOE Interoffice Work Order (B&R 8201). For SNS work to be performed by Oak Ridge National Laboratory (ORNL), budgets will be allocated internally based on approved funding packages and the availability of funds.

The DOE-OR Budget Division is responsible for transmitting the procurement request to the affected DOE field offices. The DOE field offices will accept the procurement request and authorize participating laboratories to perform work consistent with the statement of work and funding limitations.

Each laboratory participant will be subject to home laboratory internal work authorization rules (e.g., purchase orders, subcontracts, work orders, etc.). Cost and commitments will be limited by the amount of funds allocated to each participant. The SNS Project Office reserves the right to incrementally fund approved funding packages.

The Business Manager will maintain the official file for authorizing documentation that will include (1) DOE–OR directive authorization, (2) DOE work authorization documents, (3) financial plan, and (4) interoffice work order requests submitted to DOE-ORO.

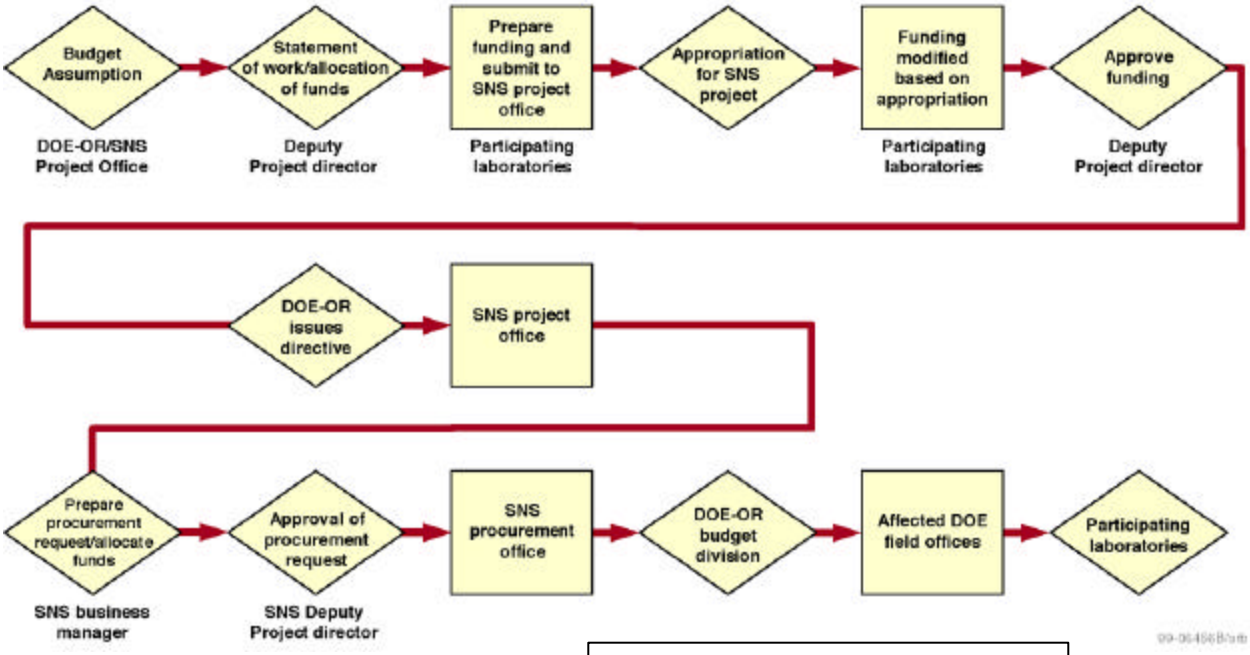


Figure 3. Funding Authorization

4.2 ANNUAL FUNDING PACKAGES

The funding package is the tool used to request money. Funding packages will be prepared by participating laboratories based on their detail schedule and submitted annually to the SNS Project Office for approval. The funding package summarizes the detailed resource loaded activities at levels 4,3 and 2. The project's cost module (MPM) calculates the BO profiles. BA profiles are provided by the partner laboratories and should reflect the month that BA is needed for actual contract execution. A separate funding package is submitted for each level 2 WBS element. The Project Office will supply the specific format, but at a minimum the packages will include:

1) Narrative description of the scope of work,
2) BCWS profiles by month for each resource loaded activity in MPM,
3) BA requirements by month at Level 2
4) BA requirements for the current year at Level 3 or 4 (paralleling the FSR levels),
5) Detailed resource loaded schedule of activities for the fiscal year, and
6) Proposed earned value methods for each resource loaded activity.

Funding packages may also be submitted to the Project Office during the year in order to initiate new work as a result of approved change requests. All funding packages involve only one type of funding. By allowing only one type of funding (i.e., operating expense, capital equipment, or line item construction) per funding package, funding integrity will be maintained. Each funding package will identify the type of funds required to perform scheduled work activities.

When purchase orders are executed near the end of a fiscal year, deliveries and payments to suppliers may not occur until the next fiscal year. When this occurs, an outstanding commitment balance will exist at the conclusion of the year. Funding package carryover funds will be used to make payments once the items are received in the new fiscal year. At the conclusion of each fiscal year, the funding package cost

plus outstanding commitment balance should provide for an effective use of funds and a smooth transition to the new fiscal year.

When a common scope of work is being performed by more than one laboratory, the funding package will identify the participants and include the BA and BO budgets with the corresponding profiles. Each performing laboratory will be responsible for preparing and submitting reports to the responsible Senior Team Leader. Again, the BO profiles will be extracted from MPM based upon the detailed schedules. The responsible Senior Team Leader will be responsible for validating this information prior to its approval in the funding package cycle. When work is performed at a performing organization that is not the responsible organization, the Senior Team Leader of the responsible organization must establish performance reporting (BCWP) procedures with the performing organization. Actual costs are submitted to the project office by each laboratory and reflect all work costed at that laboratory. The costs are reconciled with the official DOE Financial Information System and then integrated in the project's cost module and disseminated out to all partners. The responsible laboratory is responsible for comparing the actual cost (reported via the cost module) to the performance (reported by the performing organization) and analyzing variances where required.

5. BASELINE CHANGE CONTROL

5.1 CONFIGURATION MANAGEMENT PLAN

The SNS Project Configuration Management Plan (CMP) outlines the process and procedure for managing the approved Project Baselines for the technical design basis, cost/budget, and schedule/milestone parameters for the project. In addition, the CMP describes the project's contingency management plan.

5.2 CHANGE CONTROL RESPONSIBILITY

The Management Information Systems and Project Controls Manager is responsible for administrative operation and coordination of the overall baseline change control system in support of all SNS Project participants. Reporting to this manager is the Baseline Change Control Process Manager who provides administrative control and support for processing all SNS Project Change Requests (PCR's). This begins upon receipt of draft PCR's from the responsible Division Director/Senior Team Leader and continues through various reviews to the issue and distribution of approved PCR's or Baseline Change Proposals (BCP's), which require DOE review and approval.

The Project Controls Manager is responsible for implementing approved cost/budget and schedule/milestone baseline changes to the official SNS project baseline documents and files.

The Division Directors and the Senior Team Leaders are responsible for implementing all approved baseline technical/design basis changes to the official SNS project technical baseline documents and supporting technical design documents and files at all locations.

6. PERFORMANCE MEASUREMENT AND ANALYSIS

This section describes how the Performance Measurement System is part of the closed-loop project controls system described in Section 2.3.

The Project Office developed the performance measurement and reporting system, maintains the system, generates project-wide reports, and distributes reports to appropriate personnel. The STLs will generate performance data via the detail schedules, evaluate earned value within MPM, generate reports, analyze variances and implement corrective actions if needed. The essential ingredient in measuring performance is the up front definition of what is to be measured.

6.1 EARNED VALUE MEASUREMENT

6.1.1 Requirements

All work scope will be managed using earned value techniques. Budgeted Cost of Work Scheduled (BCWS) is the time-phased budget that represents the value of work to be accomplished through a given period of time. As work is actually completed, budget associated with this work is "earned" as Budgeted Cost of Work Performed (BCWP). Budgeted Cost for Work Performed is synonymous with "Earned Value." The following guidelines are followed in determination of BCWP:

- Earned value is determined using the method selected at the time of planning of the activity; that is, if a task is planned as a discrete measurable task, earned value cannot be determined as though the task was LOE.
- Every scheduled activity within a funding package that has resources assigned to it must also be assigned an earned value method (code). These codes are defined in 6.1.2.
- The selected measurement method does not change for the duration of the activity.
- Earned value is determined in a manner that is consistent with the way BCWS is planned.
- BCWP is recorded at the end of each accounting period.
- Retroactive adjustments are not made to BCWP previously reported.
- BCWP can never exceed budget at completion (BAC).

The Deputy Project Director, assisted by the Project Controls Manager, appropriate Division Director, and STLs agree on an earned value method when authorizing start work on each funding package. The following sections describe the acceptable methods. Verification of earned value reporting is accomplished through the process described in the Earned Value Verification Plan, SNS 102010200-PN001.

The current earned value options for the project are as follows:

- Code 5: % Complete. The percent complete method is intended to be used on short duration tasks of no more than several months' duration. The percent complete on the activity in the detail schedule is used to calculate earned value.

- Code 6: LOE. The level of effort method should be used sparingly, and only where there are no definable deliverables (milestones) and when tasks and activities are repetitive in nature (PM, Title III, etc.). Earned value on these activities is set as equal to BCWS.

In general, the percent complete methods are used primarily for short duration activities (i.e., four months or less). BCWP is obtained by assessing the percent complete for a particular work package based on the amount of work done versus the total amount required for the particular activity at the end of each reporting period. As discussed in Appendix F, the percent complete approach can tend to hide problems that don't surface until it is too late to correct them.

In general, the miletone method should be used on all activities over two to four months long. Since resources (and therefore earned value) cannot be associated with a milestone in Primavera, one day activities should substitute for milestones. Interim, one day activities should be established in a logical, definitive manner. As an example, suppose the task was to pour a large concrete foundation. This task will be associated with several one day activities, each having a particular percentage of the total value of the foundation estimate (e.g., excavation 20%, embedded materials installed 10%, and backfilling 10%). The total value of completing all these interim activities should be the total cost of the larger activity. Earned BCWP is obtained by completing the individual interim activities.

For material procurements, earned value can be evaluated using two different methods, in accordance with the nature of the procurement. The first method is for procurements in which the vendor receives progress payments for reaching certain identifiable, pre-established milestones. Again, one day activities, appropriately resource loaded, should be substituted for milestones to ensure correct earned value reporting. Each of these one day activities will be allocated a percentage of the total cost of the procurement during initial planning in an amount equal to the anticipated progress payment. BCWP is earned only at the completion of these activities. Generally, this is the same period of time in which the actual costs for payment to the vendor are entered in the accounting system.

The second method for evaluating BCWP for material involves procurements with no progress payments. For these procurements, the entire value of the procurement is scheduled on the anticipated delivery date. BCWP credit will be earned in the full amount upon delivery and acceptance by SNS. In general, an invoice is also issued with delivery and receipt of material occurs at the same time as the actual costs are booked in the accounting system. However, if a lag between these two actions is expected, an accrual for the invoice should be completed.

The milestone method (one day activities) should be used as often as possible to determine the earned value of activities**.**

The level of effort method should be used as little as possible and only when measuring tasks that lack definable, objective milestones or tasks that are repetitive in nature (project management, Title III support, some R&D tasks, etc.). BCWP = BCWS for this method. Materials & Services (M&S) activities should be treated as Level of Effort when the resources for these M&S activities are spread linearly across time.

6.1.2 Determination of BCWP for the AE/CM

For construction contracts, the AECM will be responsible for budgeting and collecting costs in accordance with the SNS WBS. The AECM will also be responsible for evaluating contractors' BCWP (earned value) and reporting all performance measurement data to the SNS Conventional Facilities management in accordance with the SNS WBS and accepted earned value methods.

6.1.3 Examples

In Appendix F is a sample project task showing two methods for evaluating project performance. The project has first been set-up to be measured based on a milestone method as recommended in this manual. The agreed upon measures/milestones are presented in the first section. Then the task accomplishments are described along with the ACWP, and a description of the BCWP. The next page contains the table on which the data is presented and the calculations for CV and SV as well as cumulative figures are presented. This information is then graphed to show trending. The first graph shows cumulative figures of BCWS, BCWP, and ACWP. The final graph presents the individual monthly CV and SV percent figures. This latter graph is intended to show whether the responsible manager is getting control of his task.

The next section of the appendix presents similar information for the same task with the same basic assumptions and approach, except that this time the task manager used the percentage complete approach to performance measurement. It can be seen that it is more difficult to recognize variances to budget in this manner. In fact, in this project example a problem is not seen until after the 3rd month with the percent complete method, where it is obvious that there is a potential problem in the very first month using the milestone method.

Appendix E contains more information on the development of the various aspects of Earned value.

6.2 ESTIMATE TO COMPLETE (ETC)/ESTIMATE AT COMPLETE (EAC)

A comprehensive "bottoms-up" reevaluation of the resource requirements to complete remaining scope of work may be initiated at any time at the discretion of the STL or as requested by the Project Office or DOE. However, the project has adopted a phased ETC approach based on the percentage of remaining work for each subproject. In general, every subproject is required to review their remaining work once they have passed the 50% complete stage. Another ETC is required at the 80% stage if 12 months have elapsed since the last ETC. PCRs are prepared as required and the BAC adjusted to reflect approved baseline changes. Rebaselining as a result of an approved estimate to complete may or may not include the elimination of variances by setting BCWP=BCWS=ACWP. The EAC is to be provided (at a minimum) monthly by the project STLs and Division Directors so that new information can be compiled and assessed by the Executive Management Team.

6.3 VARIANCE ANALYSIS

6.3.1 Requirements

The following requirements are used to determine cost and schedule variances:

- Status is determined on a monthly basis for all activities.
- ACWP data is obtained directly from the laboratories as an extract from the financial system and is reconciled with the Financial Status Report (FSR) to ensure that the data is consistent and reconciled to the DOE Financial Information System (FIS).
- Current month and cumulative-to-date cost and schedule variances are calculated and reported to the Project Office as specified in Section 7.1.

- At-completion variances are calculated based on performance to date and the project cost for work to be performed, taking into account corrective actions being implemented and forecasted increases/decreases and scope changes.
- Cost and schedule variances that exceed the established thresholds are analyzed, variance analysis reports prepared and reported in the Cost Performance Report (CPR) at the designated levels.
- Correction action plans are prepared by the STLs and are tracked through to close-out by the STL.

6.3.2 Variance Analysis Reporting

Variance analysis is performed to identify whether cost or schedule problems exist, whether they are improving or getting worse (i.e., the trend analysis described below in Section 6.4), who is responsible for the work associated with the difficulty, what overall impact the problem may have on the project, and what may be done to recover from or mitigate the impacts of the difficulty. Therefore, it is necessary to analyze schedule and cost variances by WBS and by participant, and to identify variance contributions associated with overhead and level-of-effort cost elements.

Cost and schedule performance variance thresholds are established at the project level and at DOE WBS reporting levels. These thresholds are expressed as plus-or-minus percent and dollar variances. When cost and schedule variances are in excess of both the percent and dollar thresholds, a variance analysis is required in the monthly progress report. The thresholds for variance reporting are shown in Section 7.0. It is the responsibility of the STL to provide performance reports to their own laboratory management, the appropriate SNS Division Director, and the Deputy Project Director.

The variance analysis sections of the monthly reports contain the STL's description of the problem, an explanation of the cause of the problem, its impact on the immediate task and on the total project, and the description of the corrective action taken or planned. The action plan to correct the problem must be endorsed by the partner senior laboratory management. Whenever the analysis indicates that a cost variance will be sustained or increased, the EAC must be re-evaluated to ensure that it reflects the actual conditions. Appendix I identifies the roles and responsibilities in variance analysis reporting. The methods for calculating variances are as shown below.

Cost Variance—Cost performance is measured by comparing work accomplished (BCWP) to actual cost (ACWP). Cost variances are expressed as follows:

Cost Variance (CV) = BCWP - ACWP
Percent Cost Variance = [(BCWP - ACWP)/BCWP] x 100

Positive variances indicate a cost underrun condition; negative variances indicate a cost overrun condition. Examples of causes for cost variances include poor initial estimates, technical difficulties requiring the application of additional resources, and cost of labor or materials different than planned.

A Cost Performance Index (CPI) will also be utilized where:

CPI = BCWP/ACWP

CPI values less than 1.0 represent "cost overrun" condition and values greater than 1.0 represent "cost underrun" condition.

Schedule Variance—Schedule performance is measured by comparing work accomplished (BCWP) with work scheduled (BCWS). Schedule variances are expressed as follows:

Schedule Variance (SV) = BCWP - BCWS
Percent Schedule Variance = [(BCWP - BCWS)/BCWS] x 100

Positive variances indicate an ahead-of-schedule condition; negative variances indicate a behind schedule condition. Examples of causes for negative schedule variances include an uncompleted constraining task, resources not available, and work completed later than planned.

A Schedule Performance Index (SPI) will also be used where:

SPI = BCWP/BCWS

SPI values less than 1.0 represent "behind schedule" condition and values greater than 1.0 represent "ahead of schedule" condition.

6.3.3 Corrective Action Monitoring

It is the STL's responsibility to monitor and report corrective actions through to resolution and to highlight the current status of the corrective actions in the monthly progress report until the variance is resolved. The Deputy Project Director reviews the status of corrective action plans during his routine reviews with the STL.

6.4 EVALUATING TRENDS

In the sections above various performance measures were discussed and the method of calculating each was defined. It is also necessary to plot these on a continuing basis to track the project trends and more precisely trends on individual elements of the WBS and major tasks.

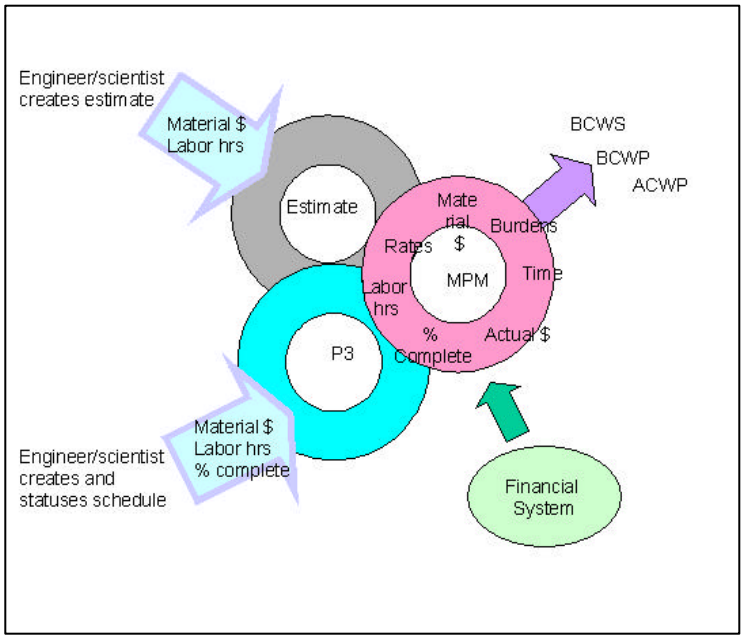
In addition, other performance measures and analyses are used for monitoring project status and assessing trends. Appendix J lists routine reports that the project office will use for this purpose. Performance measures and reports will change as appropriate to ensure they are relevant to the goals and objectives of the different phases of the project.

6.5 RESPONSIBILITIES

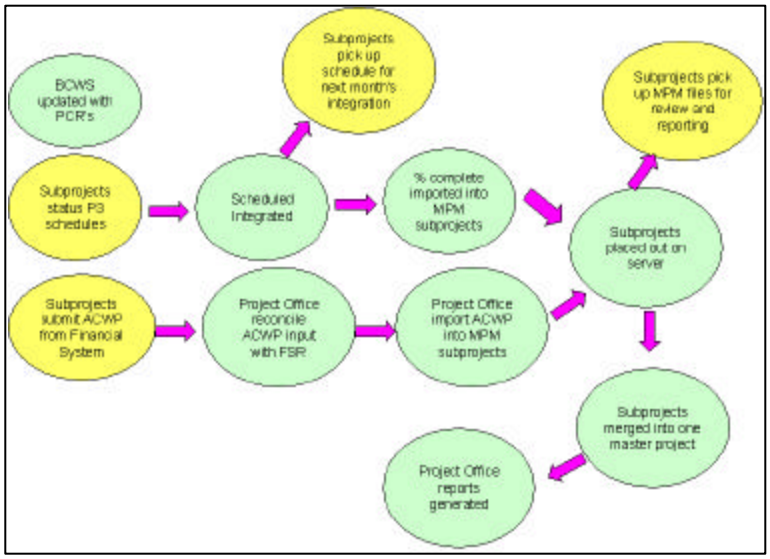
Appendix I identifies the roles and responsibilities for the Project Office and the partner labs in the performance measurement system.

6.6 SYSTEMS

The following two illustrations indicate the integration of the cost and schedule systems.



Interface and data flow between MPM, P3, the original estimate and the individua



Flow of monthly data between MPM and P3

7. RISK MANAGEMENT

7.1 PROJECT RISK MANAGEMENT HISTORY

Since the project baseline was established, risk has been managed by evaluating issues raised during technical and managerial reviews as well as those raised as a result of technical progress and implementing appropriate actions such as extending R&D, adding additional design or implementing parallel paths for back up options (e.g., mercury target and solid target). Significant progress has been achieved: the project is ~ 50% complete, technical procurement/fabrication is well along, construction is over one-third complete, and the majority of the major contracts are awarded. Therefore, the project is able to complete a more precise risk assessment for the remaining work.

7.2 RESPONSIBILITIES

The SNS Project Director has overall responsibility for project risk management and the implementation of this risk management plan. The activities required to implement the plan are delegated as follows:

Deputy Project Manager:

- Is responsible for the development of the Risk Management approach
- Will schedule periodic reviews of the risks
- Will assure the risk analysis results are documented and risk mitigation plans are brought to closure
- Will actively participate in the project's conduct of risk management, such as determination of mitigation plans, especially with interfacing risks between subprojects
- Will provide budget for risk management activities (through approval of Project Change Requests)

Senior Team Leaders/Division Directors:

- Will perform risk analysis including identifying potential vulnerabilities/risks, likelihood of occurring, and impact on the project
- Will develop risk mitigation strategies
- Will execute plan to accomplish risk reducing activities

7.3 RISK MANAGEMENT PROCESS

The project risk assessment consists of a six-step process: (1) identifying potential vulnerabilities/risks, (2) determining their likelihood of occurring, (3) assessing their impact on the project cost and schedule, (4) determining activities that would reduce/mitigate the risk, (5) executing a plan to accomplish these risk-reducing activities, and (6) risk reporting/tracking.

SNS project management evaluates project risk issues on a continuing basis. Various meetings/approaches are used for identifying project risks and discussing/tracking mitigation strategies. The routine meetings that are held to discuss key risk areas and mitigation plans are shown in the following table.

Type	Weekly	Monthly	Quarterly	Semi-Annually	As Required	PROJECT PARTICIPANTS
Executive Management Meetings	X					Executive Management Team
STL Meetings	X					Division Directors, STLs
Subproject Group Meetings	X	X			X	STLs, Staff
Performance Indicators Review Meetings		X				Executive Management Team, other Principal Project Participants
Cost/Schedule Review Meetings			X			Deputy Project Director, Division Directors, STL, and Project Controls Staff
Technical Issues Meetings		X				Project Director, Deputy Project Director, Division Directors, STLs
DOE/SNS Meetings	X					Deputy Project Director, DOE-ORO
DOE Semi-Annual Review				X		DOE-SC, DOE-ORO, SNS Staff

Management of cost, schedule and technical risks is integral to contingency management. The process used to document the probability of occurring and the impact on the project cost and schedule, and therefore the potential effects on contingency is described in Appendix L. This risk assessment will be done every six months. An updated assessment can be submitted monthly if desired however, it must be submitted whenever a new major risk is identified if that identification occurs between reporting periods.

Risks will be categorized as high, medium or low as per the following table. Two factors are combined to generate the overall rating- Likelihood or probability of occurrence and consequence to the technical performance of the machine, cost and/or schedule of the project.

Likelihood is limited to the following three categories:

- Very likely (V): This risk is likely to occur with a probability greater than or equal to 90%.
- Likely (L): This risk is likely to occur with a probability greater than or equal to 50%
- Unlikely (U): There is a less than 50% chance that this event will occur.

Consequence will identify impact that occurrence of this event will have on cost, schedule and/or technical performance of the machine. Each issue will be evaluated on these three classifications. The highest (or most critical) component will determine the final rating.

	Marginal (M)	Significant (S)	Critical (C)
Cost: Impact of this item on the project's contingency is:	≤ $1M	≤$2M	>$2M
Schedule: Impact on the project schedule is:	None	Impacts intermediate IPS milestone dates	Impacts IPS early finish dates
Technical: Impact on performance is:	Less than minor degradation	Significant degradation	CD-4 will not be met and/or future performance of the machine will not meet specified performance goals.

Based on the information from these two criteria, an overall rating will be assigned as per the following table.

Consequence

Probability

	Marginal	Significant	Critical
Very Likely	***Moderate***	***High***	***High***
Likely	***Low***	***Moderate***	***High***
Unlikely	***Low***	***Low***	***Moderate***

7.4 SPECIAL SCHEDULES

When problems of extended duration (more than several months) arise that present potential significant risks to project key schedule milestones or costs, recovery plans to include special schedules are to be prepared. These schedules can be in any form, using whatever tool is the easiest. Simplicity is encouraged as long as the level of detail ensures progress and the impact of delays can be accurately assessed. The schedules are to be reviewed by all involved managers on the project, including the Project Deputy Director and the project office staff, and formally approved by the appropriate division director. Statused schedules are to be provided, on an agreed to frequency based upon the severity of the problem, and discussed by the division director in the monthly project office metrics review meetings. Key milestones from these special schedules (e.g., go/no-go dates) are to be incorporated where appropriate into detailed subproject schedules. The milestone level for these milestones should be designated as "S" for easy tracking and evaluating impact on the total project.

8. REPORTS, MEETINGS, AND REVIEWS

8.1 PERFORMANCE REPORTING

Reporting is an integral part of the SNS Performance Measurement System, with the Monthly Progress Report being one of the key reports. Monthly status reporting is provided by the STL to the Project Office per the reporting requirements shown in Table 2 utilizing standard report formats developed by the Project Office. The Project Office will summarize the data provided by the STLs and prepare a monthly report for DOE. Included in the report will be the Cost Performance Report (CPR) Formats 1,2, and 3 and variance analysis. Other project management reports (See Appendix J) are also used and are changed or supplemented by new reports as the project progresses into different phases.

8.2 MEETINGS AND REVIEWS

In addition to performance measurement and reports, SNS relies heavily upon a series of regularly scheduled meetings and reviews to manage project technical, schedule, and cost status. These meetings provide early indications of developing trends and problems, which will be revealed later in the report data. They also provide a forum for resolving emerging problems.

8.2.1 Performance Review Meetings

Routine meetings or teleconferences will be held to review the status of the tasks from the viewpoint of cost, schedule and scope. The Deputy Project Director or his designee will chair the meetings. The status meeting format will be simple, straightforward and concise. Utilizing trend charts for cost and schedule performance, each Senior Team Leader will present task status including the following:

- Accomplishments
- Schedule and Cost Status
- Management estimate of EAC
- Procurement Status
- Staffing Status
- Top Issues
- Key Activities in the next 60 days

It should be noted that the focus is primarily on the most recent period, the upcoming few months and the previous months. It is expected that each presentation and discussion following this format will be completed in no more than one hour.

8.2.2 Other Meetings

Table 3 shows a listing of other routine project meetings.

Table 2. Monthly Progress Report

Information/Report	Narrative	Cost	Schedule
Monthly Report to DOE Data submitted monthly by STL's; Project Office compiles, submits report.	• Status for each WBS L-2 element	• Cost Performance Report (CPR) for each L-2 element Format 1: WBS Format 2: Participant Format 3: Baseline • Justification/correction plan for variances exceeding WBS L-2 thresholds: 25% unfavorable cost variance in the current month 10% cumulative unfavorable cost variance • Estimate at Completion • Project Office compiles trend data consisting of: cumulative BCWS by month cumulative ACWP and BCWP to date, by month cumulative commitments to date by month cumulative BA allocated by month • Estimate at Completion	• Cost Performance Report (CPR) for each WBS L-2 Format 1: WBS Format 2: Participant Format 3: Baseline • Justification/correction plan for variances exceeding WBS L-2 thresholds: 25% unfavorable schedule variance in the current month 10% cumulative unfavorable schedule variance • Level 0-2 milestones made or missed and forecast dates • Critical path listing[a] • Schedule activities: % complete and start/finish forecast dates
Information sent to Project Office quarterly by STLs	• Status for each WBS Level-3/4 • Work progress, work expected to be performed in the near future, problems encountered or anticipated. • Analysis of trends	• Cost Performance Report (CPR) for each L-3 element; L-4 for Conventional Facilities and Linac Systems (LANL)	• Cost Performance Report (CPR) for each WBS L-3; L-4 for Conventional Facilities and Linac Systems (LANL)

[a]Listing of activities on the project critical path and the activities with less than 30 days of float with respect to the critical path.

Table 2. Continued

Information/Report	Narrative	Cost	Schedule
		• Justification/correction plan for variances exceeding thresholds at WBS L-3; L-4 for Conventional Facilities and Linac Systems: ±25% and $25K cost variance in the current month • ±10% and $50K cumulative cost variance	• Justification/correction plan for variances exceeding thresholds at WBS L-3. L-4 for Conventional Facilities and Linac Systems. ±25% and $25K schedule variance in the current month ±10% and $50K cumulative schedule variance • Level 0,1,2&3 milestones made or missed and forecast dates, including justification if milestones missed; any milestone made or missed affecting the critical path, including forecast date and justification if missed
Information maintained by Senior Task Leaders at each laboratory (but not reported to the Project Office) on a monthly basis for the current year.	Detailed knowledge of all work being performed.	• Cost Performance Report (CPR) data for lower level elements	• Cost Performance Report (CPR) data for lower level elements • Lower level milestones made or missed and forecast dates

Table 3. Listing of routine project meetings.

Type	Chair/Purpose	Frequency				Attendees
		Weekly	Monthly	Semi-Annually	As Required	
Executive Management Meetings	Chair: Project Director; Discuss project status, issues, major changes in scope, cost, or schedule, advisory committee involvement, user coordination	X				Executive Management Team
Deputy Project Director's Staff Meetings	Chair:Deputy Project Director; Discuss upcoming events, funding status, change requests, overall status issues	X				Project Staff, Division Directors
STL Meetings	Chair: Deputy Project Director; Discuss project wide status and issues, including R&D	X				Division Directors, STLs
Subproject/Division Group Meetings	Chair: Division Directors and/or STLs; Disseminate information, address issues of concern to subproject	X	X		X	STLs and Staff
Technical Information Meetings	Chair: Division Director; Disseminate technical information and status				X	Project Participants
General Project Meetings	Chair: Project Director; Review overall project including cost, schedule and technical issues			X	X	Principal Project Participants
Cost/Schedule Review Meetings	Chair: Deputy Project Director; Review cost and schedule performance with STL		~X/3 (per STL)			STL and Project Controls Staff
Project Controls Meetings	Chair: Project controls manager; Discuss project controls actions/issues		X/2			Bi-weekly. Project controls staff at partner labs
Design Reviews					X	As required
DOE/SNS Meetings	Chair: Deputy Project Director; Review technical cost, and schedule status, other issues	X				Deputy Project Director, DOE-ORO,
DOE/SNS Performance Indicators Review Meetings	Chair: Project Director; Review technical cost, schedule status, staffing needs, safety and QA issues on monthly basis		X			Project Director, DOE-ORO, Principal Project Participants
DOE Semi-Annual Review	Review technical, cost and schedule, management status, present revised bottoms up cost estimate			X		DOE, SNS Staff
Advisory Committees	Provide managerial and technical assistance				X	As required
Specific Topic Meetings	Discuss specific topics with project participants (e.g., QA, Document Control)				X	As required

Independent Reviews					X	As required

APPENDIX A

DEFINITIONS

APPENDIX A. DEFINITIONS

Accounting accrual—Expenses or an estimate of expenses that have been incurred and posted in the cost accounting systems, but have not actually been paid.

Activity—A unique work task, approximately 4–6 months duration, identified in the schedule.

Activity Code—An alphanumeric identifier assigned to each project activity (in Primavera) to add information for updating, analyzing, reporting, plotting, summarizing, and grouping activities. Must contain the WBS element ID.

Activity ID Code—Unique number assigned to an activity (in Primavera) much like a serial number.

Actual Progress to-date—The sum of the cumulative BCWP to-date for WBS elements 1.3 through 1.9. The percentage is calculated by dividing the sum of the cumulative BCWP to-date by the Budget at Completion for WBS elements 1.3 through 1.9.

ACWP—actual cost incurred as reported through laboratory cost accounting systems + accruals

BAC—budget at completion is the total estimate for a work package or activity (excludes contingency)

BCWP—budgeted cost of work performed or EARNED VALUE is the value earned for accomplishment of specific pieces of the defined work. This is not the same as what it has cost to achieve the progress made (50% of the cost spent does not necessarily mean that the work is 50% complete)

BCWS—Cost plan based on the budgeted value of a scope of work, time-phased based on the schedule for the scope of work.

Budget authority (BA)—Total budget available (including carryover funds) to cover both cost and commitments.

Budget outlays (BO)—Funds required to cover estimated cost, typically BCWS.

Building Area—An activity code that will be assigned to a task identifying its location in terms of a particular building or building area on the SNS site.

Capital Equipment Not Related to Construction—Capital items projected to cost $25,000 or more and have a service life of greater than 2 years and to be used in conducting SNS research and development.

Charge Code—an optional code used to identify the account to which cost will accrue for a resource or an activity. This code should be the same as the code in the financial system used to collect charges.

Commitments—Funds allocated to subcontractors where the work has been authorized but not yet expensed.

Completion variance—Completion Variance = BAC minus EAC (a negative result is unfavorable, cost overrun)

Construction and Fabrication Activities (Capital Funded)—Construction and fabrication activities generally include the design and engineering for a specific project or for the components of a project after the ideas or conceptual design are crystallized; the procurement, fabrication, erection, and installation of all materials and equipment constituting the project; models built for size and spacing in connection with preliminary (Title I) and final (Title II) design work; the preparation of operating manuals; and the pre-operational testing of the project components.

Contingency—An amount budgeted to cover costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties. The amount of contingency will depend on the status of design, procurement, and construction and the complexity and uncertainties of the component parts of the project. Contingency is not to be used to avoid making an accurate assessment of expected cost.

Contractor encumbrance (commitment)—Consists of uncosted balances of legally enforceable agreements (e.g., purchase orders, subcontracts, task orders, etc.).

Cost Performance Index (CPI)—Represents the relationship between the actual cost expended and the value of the physical work performed. CPI = BCWP/ACWP.

Cost-reimbursement subcontract—Type of subcontract that (1) establishes an estimate of the total cost of performance for the purpose of committing funds and specifying a ceiling that the subcontractor cannot exceed (except at its own risk) without the approval of the laboratory; (2) requires the periodic reimbursement of the subcontractor's costs during performance; and (3) does not involve an enforceable promise by the subcontractor to complete the work with estimated funds, but only a commitment to use its best efforts to do so.

Cost Variance Percent (CV%)—The cost variance as a percent of the Earned Value. CV% = CV/BCWP.

Construction Management—Those services provided by the organization responsible for management of the construction effort during Title I & II design and continuing through the completion of construction.

Commissioning Costs—Costs associated with authorizing a facility to operate.

Cost Account—Defines the functional (WBS) responsibility for a block of work, BCWS, and BCWP; provides the cost collection point for ACWP. May contain one or more charge codes.

Cost Estimate—A documented statement of costs estimated to be incurred to complete the project. Cost estimates provide baselines against which cost comparisons are made during the life of the project.

Cost variance—current period and cumulative
CV = BCWP (Earned Value)-ACWP
(a negative result is unfavorable, cost overrun)

Critical path—A sequential path of activities in a network schedule, which determines the necessary duration of a project. Any slippage of the tasks in the critical path will increase the duration of a project.

Critical subcontractor—A contractor performing a complex portion of a contract, which requires a flow down of cost performance reporting requirements. Critical subcontractors are designated as a result of negotiation or management direction.

Department—An optional activity code that may be used to identify a particular department of an organization that will perform the activity.

Data Date—The data date is the AS OF date. The date status has been included in the schedule.

Division—An optional activity code that may be used to identify a particular division of an organization that will perform the activity.

Directive—A programmatic document issued to ORNL by the Department of Energy (DOE), which authorizes the commitment and expenditure of funds for specific projects or major activities.

Earned value—An objective measure of progress that is based on the budgeted value of work performed.

Estimate at completion (EAC)— Forecast final cost of a scope of work based on the current ACWP plus a management assessment of the cost to complete the remaining scope of work.

Engineering, Design, and Inspection (ED&I)—ED&I activities include the engineering and design activities in Title I and Title II and the inspection activities associated with Title III.

ETC—estimate to complete is the latest estimate of budget required to finish the work remaining.

Field Work Proposal (FWP)—A basic work support document used to provide information for program planning or budget formulation (operating, expense and capital equipment not related to construction).

Financial Plan—A financial document issued to ORNL by DOE, which authorizes the commitment and expenditure of funds in total for budgeted programs and activities.

Fixed-price subcontract—Type of subcontract that requires the subcontractor to deliver acceptable supplies or perform acceptable services as a precondition to receiving payment of the price.

Funding Package—Tool used to request funding for a fiscal year. A basic building block used to identify the scope of work, the schedule, and the budget for the work planned in a fiscal year.

Group—An optional activity code in Primavera that may be used to identify a particular group of an organization that will perform the activity.

Indirect Costs—Costs incurred by an organization for common or joint objectives, and which cannot be identified specifically with a particular activity or project (e.g., laboratory overhead).

Inter-project Link (IPL)—A logical link between a milestone in one subproject and another milestone in a different subproject affecting the start or completion of an activity.

Line Item (LI)—Fund "type" for design, procurement, construction, fabrication, installation, and pre-operational testing of a capital facility.

Master Project—The integrated, rolled up SNS schedule consisting of the nine subprojects.

Micro-Frame Program Manager—The selected cost processing software for the project.

Milestone—An activity representing a significant schedule occurrence at a point in time.

New budget authority—BA provided in the current fiscal year.

Obligation Plan—Time-phased plan of how each laboratory plans to commit their Allocated BA. Labor and materials and supplies are typically time-phased as expended, while procurements are typically time-phased at award of contract plus award of any contract options.

OBS1 (Reporting Manager)—An optional activity code in Primavera that may be used to identify a responsible individual assigned to activity.

Other Project Cost (OPC)—Fund "types" (Operating Expense and Capital Equipment) supporting, but not directly contributing to a LI construction project, generally include research and development and pre-operation activities.

Participant—A required activity code in Primavera that identifies a particular laboratory or subcontractor that has responsibility to accomplish an activity.

Performance Measurement Baseline—The time-phased budget plan against which project performance is measured.

Planned Progress to-date—The sum of the cumulative BCWS to-date for WBS elements 1.3 through 1.9. The percentage is calculated by dividing the sum of the cumulative BCWS to-date by the Budget at Completion for WBS elements 1.3 through 1.9.

Project Data Sheet—Used to explain and justify to Congress the need for project funding for new project efforts and for any ongoing projects that require Congressional authorization/appropriation. Project data sheets are the primary documents used to defend funding for projects throughout the budget formulation process.

PRIMAVERA—Primavera Project Planner (P3) is the selected schedule software for the project.

Project Group—A project group is a collection of one or more projects combined to form an integrated project group (in Primavera). The overall SNS project is defined as a project group.

Project Management—Covers those services provided to the DOE on a specific project, beginning at the start of design and continuing through the completion of construction, for planning, organizing, directing, controlling, and reporting on the status of the project. It includes developing and maintaining the project management plan; managing project resources; establishing and implementing management systems, including performance measurement systems; and approving and implementing changes to the project baseline

Project Office—When used in this document, the term "Project Office" means the SNS Project Office in Oak Ridge that provides project management functions for all subprojects.

Project Phase—A required activity code that defines the type, such as design, procurement, fabrication, installation, testing, etc., of the activity.

Research and Development Activities (Operating Expense Funded and Capital Equipment not Related to Construction*)*—Research and development activities generally include all work, up to the time when the ideas or conceptual design for the project or individual components are crystallized and are ready for the preliminary design work (Title I) leading to a specific construction or fabrication project. Research and development activities include the development of conceptual designs, origination of ideas, and investigations to obtain scientific and engineering data, as well as activities directed toward the investigation and development of technical improvements in such projects, processes, systems, or components during the construction or fabrication period.

The transition from the research and development phase to the construction and fabrication phase generally will not occur at one time because the design and construction fabrication of some systems and components may be in progress while research and development work on other systems and components is being continued. Further, with respect to a given component, research and development may be continuing simultaneously with its fabrication or construction to optimize the design and quality of the particular component and its integration into the plant as a whole. Research and development expense funds shall not be used for activities or items that are to be capital funded.

Report Code—An optional activity code in Primavera that may be used for sorting project activities.

Schedule Performance Index (SPI)—Represents the relationship between the value of the initial planned schedule and the value of the physical work performed, or Earned Value. SPI = BCWP/BCWS.

Schedule variance—SV = BCWP (Earned Value)-BCWS (a negative result is unfavorable, behind schedule)

Schedule Variance Percent (SV%)—The schedule variance as a percent of the performance baseline. SV% = SV/BCWS.

Start-up Costs—Covers one-time costs incurred by the integrated operating-contractor during the transition between the completion of construction and operation of the facility. All such costs are charged to operating expense. They include the following:

a. Operations planning, operator training, and operational readiness review;
b. Startup coordination, post-acceptance testing, cost of startup chemicals, and related supplies; and
c. Salaries of startup personnel.

STL (Senior Team Leader)—The manager responsible for work, money, schedule, deliverables and reporting for a subproject.

Subproject—Each major schedule group is defined as a subproject. The Linac, Front End, Ring, Target, Experiment Systems, Conventional Facilities, and Operations, with their associated R&D and Integrated Controls, are each defined and scheduled as a subproject.

Subproject Identifier—An activity code used by P3 to associate the activity number with a subproject. It is usually the first two characters of the task activity ID.

Subsystems—An optional activity code in Primavera that may be used to define a subsystem at WBS level 4 or below.

Total Estimated Cost (TEC)—The anticipated capital costs directly associated with design and construction of the facility. The TEC includes design, construction, equipment and its installation and associated management, contingency, and escalation. These typically require project specific congressional authorization.

Total Project Cost (TPC)—Consists of all the costs included in the TEC of a construction project plus the pre-construction costs such as conceptual design and R&D, plus the costs associated with the pre-operational phase such as training and startup costs.

Unburdened Cost—Cost calculated from listings of materials or equipment and quantities, man-hours needed and labor rates, or other fundamental cost estimating techniques but not including overhead costs. Where costs are quoted from equipment suppliers or construction contractors, the cost quoted can be used as unburdened cost - there is no need to separately obtain indirect or overhead costs from suppliers or construction contractors. FPSC indirect cost is included in unburdened cost.

Undistributed budget—part of the Performance Budget Baseline that has not been distributed to a specific WBS element or organizational element.

Variance—The difference between the expected/budgeted/planned and the actual results.

Variance at completion (VAC)—The algebraic difference between budget at completion and estimate at completion (VAC = BAC!EAC).

Vendor Submittals/Quotes—Documents provided by vendors on their equipment and materials. These documents are used to determine whether or not the equipment meets the specifications of the purchase order.

Work authorization document—The document provided by DOE that authorizes the performance of work by ORNL on receipt of funding in the official DOE-ORO/ORNL financial plan.

Work Breakdown Structure (WBS)—A breakdown of a project into those sub elements that define a project. The WBS provides a consistent organization framework throughout the project.

WBS Level 2 Rollup—A required activity code that reflects level 2 of the WBS.
WBS Level 3 Rollup—A required activity code that reflects level 3 of the WBS.
WBS Level 4 Rollup—A required activity code that reflects level 4 of the WBS.
WBS Level 5 Rollup—A required activity code that reflects level 5 of the WBS.
WBS Level 6 Rollup—An optional activity code that reflects level 6 of the WBS.

APPENDIX B

COST ESTIMATING

APPENDIX B.COST ESTIMATING

1. PURPOSE AND OBJECTIVES

This appendix provides requirements and guidance for generating, documenting and maintaining the project cost estimate in a verifiable form. From the period of July 1999 through July 2001, the project retained a current cost estimate in the form of the CEDB (Cost Estimate Data Base). This was maintained in FY99 dollars. In July 2001, an Estimate to Complete (ETC) process was commenced that utilized current year rates and a different format from that used in the CEDB. Subsequent to that ETC, the project has adopted a phased approach in which subprojects are directed to review their estimates to complete based upon their planned progress through a particular period.

This chapter includes requirements for all aspects of generating a cost estimate, including the application of overhead and other burdens as related to the ETC (or any estimate change that affects the project baseline). It is recognized that engineering personnel will deal almost exclusively with determining labor hours required for tasks and equipment supplier quotes for procured equipment. The project's cost module, Microframe Program Manager (MPM) will apply appropriate overhead rates to calculate burdened costs. The requirements and guidance in this document are based on the DOE Cost Estimating Guide dated November 1994 and experience from other accelerator construction projects.

The cost estimate for the ETC should reflect the SNS Project goal to maximize the number of world-class instruments within the initial project scope. To achieve this goal, all scope must be accomplished for as low a cost as possible. Thus, cost estimates should be challenging in that:

- the cost estimate for each line item component or task should be near the optimistic (or low) end of the realistic range for meeting requirements and specifications, performing reliably, and allowing cost-effective maintenance and operations
- estimates should be "bare bones" (e.g. not accommodate unnecessary features) and not be so low as to be unbelievable, nor so high that managers feel fully comfortable and confident of success
- estimates should include credibly optimistic assumptions for quantity discounts and manufacturing/assembly economies, and be based on the most cost-effective strategy for accomplishing the work
- estimates should generally assume that planned R&D will be successful.

2. GENERATING A COST ESTIMATE

2.1 DEFINITION OF THE DELIVERABLE:

- Backup materials for all estimates will be retained by the Subprojects.
- Input files of unescalated estimates for input into MPM will be maintained at the Project Office. These files will be delivered to the project office as Excel files, as P3 files or as MPM files and will be retained in the PCR system as attachments to the PCR which requested their incorporation into the baseline.

- Labor and overhead rates used to generate the estimate will be provided by the subproject. Overhead rate change policy is described in Appendix G. The MPM rate table will only be changed by an approved PCR.
- Labor will be estimated in hours. MPM will apply the rates (including appropriate burden and overhead rates) based on the input from the subproject.
- Estimate data will be imported into MPM. MPM will apply DOE escalation factors and provide an escalated Estimate to Complete (ETC).

2.2 LEVEL OF DETAIL:

- Estimates should be calculated at the P3 activity level.
- Estimates should be based on labor hours (with appropriate labor rates for labor costs) and vendor quotes for procured equipment costs to the maximum extent practical. Estimates for shop labor should list the labor hours for each craft, technician, supervisor, or other labor type used. To be more efficient, ED&I costs should be estimated on the basis of groups of personnel performing ED&I work on common tasks (such as design of magnets in a subproject or system) rather than estimating ED&I cost for each item listed in the estimate.
- Cost estimates should reflect appropriate acquisition planning and installation planning.
- Backup material should include vendor quotes, catalog cuts, detailed listings, and other data that clearly shows the basis of the estimate.
  - Acquisition planning should consider equipment and services to be procured, equipment manufactured in-house, needs for upgrading industry and/or laboratory facilities, and other applicable activities needed to fabricate, inspect, test, and deliver equipment or systems.
  - Installation planning should consider technical components to be installed by the CM and laboratory forces, the building conditions and CM provided equipment and services needed, and the laboratory personnel needed to perform the installation activities.

2.3 SCOPE OF WORK

The most current baseline forms the basis for all estimates to complete. The defined scope, WBS descriptors and technical parameters are defined in the SNS Parameter List.

2.4 CONTINGENCY ANALYSIS

The Risk Management process is used to identify uncertainties within the current estimate. See Chapter 7 and Appendix L for details.

2.5 START DATE

The project's total cost estimate includes the cost of all activities in the schedule as of September 1998.

2.6 ESCALATION RATES

The escalation rates used are those supplied to the project by the Department of Energy.

2.7 ESTIMATE GUIDANCE

2.7.1 Fabrication/ Installation Cost—The cost of fabrication and installing equipment at the SNS site. (Phase codes FB and IN – see Appendix C)

Use the craft labor resources supplied by Project Office for "Davis Bacon" craft labor provided by FPSC construction labor managed by the CM.

Include cost for handling technical components one time (moving the equipment from a delivery truck or the warehouse where it is stored). Present planning calls for moving technical components through the RATS Building (Receiving, Assembly, Testing and Storage).

Estimates should clearly designate which equipment is to be installed by laboratory technicians and crafts and which is to be installed by the CM. Using the appropriate resource code that will indicate the resource that will be performing the activity performs this designation.

Where equipment is to be installed by laboratory technicians and crafts, the estimate should include the cost of travel and other ancillary expenses needed to support the installation. If CM support (FPSC or direct hire) to laboratory forces is required, the estimate should clearly show the number of hours of the CM forces needed.

Where the equipment is to be installed by CM forces, the estimate should list the crafts needed to perform the installation.

2.7.2 Spares (Phase code SP – see Appendix C)

This includes all spares and bench stock needed to successfully complete testing, commissioning, and operations prior to the end of the project (completion of the project acceptance test). The cost for spares should be clearly indicated in the estimate as separate items in the cost data listing. The project office will review all spare cost before inclusion into baseline estimate.

2.7.3 Title I and Title II design (Phase code T2 – see Appendix C)

This includes all Title I and Title II design as well as component specific physics.

2.7.4 Title III (Phase code T3 – see Appendix C)

This includes all Title III support activities. Title III does not refer to fabrication activities themselves; it does refer to oversight during the fabrication process.

2.7.5 Shop Equipment (Phase code PR – see Appendix C)

The estimate should include the cost for all shop equipment, general purpose and special purpose, which are required to make the SNS a complete, fully functional facility. For example, if a facility to recondition klystrons is needed by the SNS, the cost for it should be included in WBS 1.4.

2.7.6 Project Services - includes project management, construction management, and technical support (Phase code PM – see Appendix C)

This includes project management, ES&H, QA, systems engineering, and other project services to be provided by the project office is described in the Project Execution Plan. Laboratories and/or AE/CM should provide all other project services needed to successfully deliver a functioning subproject.

The estimate should clearly indicate the difference between these project management support activities and the technical support activities comprising Title III design.

2.7.7 System Testing , Commissioning, and Operations – The cost for support activities for system testing, and commissioning provided by laboratories for technical systems and the AE/CM for Conventional Facilities. (Phase codes TE, CS, and OP – see Appendix C)

Systems Testing (testing without beam)

- Systems testing activities begin following the completion of installation and checkout activities.
- Systems testing should be completed prior to the Readiness Review for commissioning.

Commissioning (testing with beam)

- Commissioning will begin after completion of Readiness Review for commissioning.
- Commissioning ends with completion of the Subproject Acceptance Test and marks the transition from Commissioning to Subproject Operations

Operations

The Pre-Ops staff to provide beam for other systems during their commissioning phase will operate systems that have completed Commissioning. Laboratory support will be on an ad hoc basis. ORNL will provide cost in WBS 1.10 to fund this support.

The estimate should clearly indicate the difference between the project management support activities and these technical support activities.

2.7.6 Survey and Alignment (Phase codes CN, IN, OP– see Appendix C)

The same crew consisting of a mixture of CM and Pre-Ops personnel will perform all survey and alignment. Survey and alignment will be conducted as follows:

- Building construction: Survey of building structures should be performed before the settlement period begins, and at appropriate points during the settlement period to insure building requirements are met and to provide information to design, installation, and operations planning personnel.

- Installation: Rough survey and alignment of technical components should be performed as part of the installation process.

- Pre-Commissioning - Final survey and alignment should be performed prior to commissioning to insure that systems are ready for testing with beam.

Operations—Survey and alignment should be performed during and after commissioning as needed to provide acceptable operation.

2.7.7 Application software development (Phase code SW – see Appendix C)

This is the cost of custom software application development performed by laboratories and the AE or CM (not FPSC) labor (including the cost of subcontractors used for software development services). This includes custom PLC software provided by laboratory or AE/CM labor but not PLC software or configuration provided by equipment suppliers or CM managed FPSCs. Note: Software development funded by WBS 1.1 and WBS 1.10 is phase RD and OP respectively—not SW. Also, the cost of travel, computer hardware, workstations, office supplies, etc. is phase code PR—not SW.

2.7.8 Shipping and Dunnage cost (Phase code PR – see Appendix C)

This cost does not have to be listed as separate items in the estimate but should either be clearly visible in the estimate or the basis of cost should state that this cost is included in estimates for equipment.

2.7.9 Heavy equipment rental and small tools—Cost allowances for heavy equipment rental and small tools needed to support installation, testing, commissioning, etc. (Phase code PR – see Appendix C)

Any equipment that should be provided by the CM should be clearly shown in the estimate.

2.8 DEFINITION OF TERMS—Cost estimating should be consistent with the definitions of research and development (operating expense), capital equipment not related to construction, and line item construction as defined by DOE.

APPENDIX C

SCHEDULE DEVELOPMENT

APPENDIX C.SCHEDULE DEVELOPMENT

1. INTRODUCTION

This appendix provides the framework to develop and maintain a subproject schedule for SNS. It is not intended to provide a tutorial for software, work packages, or cost reporting, although these facets of project control are contained in this document. Subproject schedules are the responsibility of, and will be developed by, project participants using this framework.

1.1 SCHEDULE REQUIREMENTS

Primavera Project Planner (P3) has been selected as the scheduling software for the SNS project. The current version is 3.1; any version updates will be coordinated by the project office.

The SNS project schedule will consist of eleven subproject schedules integrated in a master schedule. The subprojects will be grouped by technical function so that all work unique to the technical function will be contained within the subproject schedule. Each major WBS task subproject is indicated in the table below:

Subproject Schedule	WBS
Project Support	1.1.13, 1.2
Front End Systems	1.3 (less 1.3.5-1.3.6), 1.1.1, and 1.9.3
Linac Systems (LANL)	1.4.1-1.4.6,1.4.9, 1.1.2, and 1.9.4
Linac Systems (JLAB)	1.4.8, 1.4.10-1.4.15 and 1.1.11
Ring Systems	1.5 5 (less 1.5.13-1.5.14), 1.1.3, and 1.9.
Target Systems	1.6, 1.1.4 – 7, 1.1.10, and 1.9.6
Instrument Systems	1.7, 1.1.8
Conventional Facilities	1.8
Controls	1.9.1, 1.9.2, 1.9.8-1.9.10 and 1.1.9
Operations	1.10.3-1.10.6
Accelerator Systems Division	1.1.12, 1.10.1, 1.10.2, 1.4.7, 1.5.13-1.5.14, 1.3.5-1.3.6, 1.4.16-1.4.20

Schedule activities should be defined in a minimum of WBS Level 4 elements. Lower WBS Level may be required for sufficient schedule detail.

1.2 SCHEDULE DEVELOPMENT

1.2.1 Project Identification

In order to differentiate between projects within P3, a subproject ID and abbreviated name has been assigned to each subproject schedule. These names have been assigned by the Project Office and are required to consolidate the project into one consistent project schedule. Project identification numbers and associated four-character project names used by P3, both of which are under configuration control, are listed below.

Subproject	Subproject ID	Subproject Name Abbreviation
Project Support	PS	PROJ
Front End Systems	FE	FRON
Linac Systems (LANL)	LN	LINA
Linac Systems (JLAB)	SL	JLAB
Ring Systems	RI	RING
Target Systems	TG	TARG
Instrument Systems	EX	EXPE
Conventional Facilities	CF	CONV
Controls	CT	CONT
Pre-Operations	OP	OPER
Accelerator Systems Division	AS	ASD

The first version of the master project is named SNS0. Subsequent major baseline changes will be identified by SNS1, SNS2, etc. The version current as of 14 April 2001 is SNS07. A major baseline change is defined as a change to Level 0 or Level 1 milestones or budgets or at a significant break point in the schedule.

1.2.2 Activity ID Numbers

Each activity or milestone is assigned a unique ten-character identification number. Each 10-digit number will begin with the 2 digit sub-project ID. The remaining 8 digits are at the discretion of the sub-project. Once an activity has been baselined in the Project's cost module, MPM, the activity ID cannot be changed.

1.2.3 Activity Codes

Activity codes associated with each schedule activity provide additional information about that activity. The project office has defined the overall SNS code structure. It contains several required and optional fields to identify and categorize each task. Each subproject uses this code structure to define attributes for its activities. The optional codes have been established for use by the participating laboratories. An Activity Code Dictionary has been developed, will be maintained in P3, and will be the standard for the master project and subproject code structure. It will define only the required activity codes including the character length of each, the structure of the optional codes, and the sequence in the dictionary. The intent is to define only those codes essential to the development of the SNS project schedule and to leave as much flexibility as possible. The following pages describe the contents of the Activity Code Dictionary.

Mandatory Codes (Length)	Optional Codes (Length)
1. Participant (2)	9. Milestone Type (1)
2. Project Phase (2)	10. Special Reports (3)
3. WBS Level 2 (3)	11. Reporting Manager (2)
4. WBS Level 3 (5)	12. Division (2)
5. WBS Level 4 (7)	13. Group (2)
6. WBS Level 5 (9)	14. MPID (10)
7. WBS Level 6 (10)	15. MPM Earned Value (1)
8. Milestone Level (1)	16. Building (3)
	17. External Interfaces (1)

The sequence of the codes in the dictionary and number of spaces allocated for each code is important and must be maintained for proper master schedule integration.

Participants—The participant code field is a mandatory code field that identifies the laboratory or AE/CM team member associated with the project. The participants and the associated participant codes are listed below:

Participant Code	Participant
AN	ANL
LB	LBNL
BN	BNL
LN	LANL
SL	JLAB
OR	ORNL
AE	Architect Engineer
CM	Construction Manager

Associated subcontractors will be assigned to the appropriate participant code.

Project Phase—The project phase (PHSE) is a mandatory code for all activities. The project phases to be used and their definitions are shown below.

RD – Use on all activities in WBS 1.01 except procurements. All procurements in WBS 1.01 should be coded with PR as applicable.

PM – Use on all activities in WBS elements 1.02 through 1.09 that involve management or management support. This includes any activities involving general physics and project office management, systems engineering, procurement, QA and ES&H. This includes laboratory management oversight during the pre-OPS (including Readiness Reviews) and Commissioning phases. AE management activities should be coded as T1/T2; CM management activities should be coded CN. Bid and award activities can be included here or with the PR activity. Materials and equipment procured for these activities should be coded with PR as applicable.

PR – Use on all activities involving the procurement of materials or equipment. Materials are defined as computers, supplies, materials for fabrication of equipment and construction materials procured by the laboratories, AE or CM. This code is to be added to all milestones and procurement activities associated with the procurement.

SP– Use this on all activities for spares procurement for commissioning spares as appropriate.

FB – Use on all fabrication activities. Fabrication activities should be predominantly labor. If these activities involve predominantly material or equipment resources, then the activity should be separated into two individual activities coded as PR and FB.

T2 – Use on all activities involving Title I and Title II design as well as component specific physics.

T3 – Use on all Title III support activities. Title III does not refer to fabrication activities themselves; it does refer to oversight during the fabrication process.

SW – Use on all activities involving the custom software application development performed by laboratories and the AE or CM labor (including the cost of subcontractors used for software development services). This includes custom PLC software provided by laboratory or AE/CM labor. Note: Software development in WBS 1.1 and WBS 1.10 is coded RD and OP respectively – not SW. Also, activities involving travel and the procurement of computer hardware, workstations, office supplies are coded PR - not SW.

IN – Use on all activities involving installation of technical components at the SNS site. Installation activities start at RFE/BOD. Activities covering the installation of conventional facilities equipment should be coded with CN. Laboratory oversight should be covered by PM or T3 activities.

CN – Use on all construction activities involving conventional facilities. This includes activities covering FPSC provided materials, equipment, and craft labor to construct facilities or installing conventional facilities equipment at the SNS site.

OP – Use this on all activities in WBS 1.10 that involve physics and engineering support. This includes activities such as readiness reviews and technical support during testing.

TE – Use on all activities involving system testing following the completion of installation and prior to commissioning. This only reflects activities involving technician labor on site at SNS. Oversight activities provided by partner laboratories should be coded as T3.

CS – Use on all activities directly involving commissioning (with beam) (WBS 1.10 only). Oversight activities provided by partner laboratories should be coded as T3.

LA – Use on all activities that are not otherwise defined above to encompass labor used for shop labor, inspection, testing, etc. This effort in WBS 1.1 and 1.10 is code RD and OP respectively. Field Coordination effort is LA.

WBS Level 2 Through 6 Roll-Up—These codes are used to summarize several levels of the WBS and are required for preparing reports at the project level. The WBS roll-up is essentially the WBS without the periods separating the levels. For example:

WBS	WBS Level
Level 2 (3 digits)	
1.02.05	102
1.08.13.06	108
Level 3 (5 digits)	
1.02.05	10205
1.08.13.06	10813
Level 4 (7 digits)	
1.02.05	10205
1.08.13.06	1081306
Level 5 (9 digits)	
1.02.05.01	1020501
1.08.13.06.01	108130601
Level 6 (10 digits)	
1.02.05.01	020501
1.08.13.06.01.01	0813060101
Note: At this level, the Level 1 digit is dropped.	

These WBS fields are due to the limited ability within P3 to roll-up by WBS in many of its reports. It is recommended that these fields be populated via a global change in P3. This routine, based upon the WBS number, will reduce errors and save a great deal of data input time. Contact the project office for help with building the global change.

Milestones—Milestones are identified as finish or start. The level must also be identified, level 0 through level 9. Previously identified code fields will also be entered. Milestone activity codes are:

0 Level 0 Milestone - DOE Acquisition Executive
1 Level 1 Milestone - DOE Program Office
2 Level 2 Milestone - DOE Project Office
3 Level 3 Milestone – Deputy Project Director
4 5–9 Level 4 - 9 Milestones - Milestones identified by the Division Directors/STLs for internal project control

Milestones that are needed to assign and calculate earned value and to show start or finish of significant project tasks will be identified. Level 0,1 and 2, milestones are identified in the Project Execution Plan and must be included in the appropriate subproject schedule. Level 3 milestones should be assigned by the Senior Team Leader. These are the milestones that will be reviewed monthly by the Deputy Project Director. Activities/milestones in the schedule that are used to measure the status of the IPS should be coded as L3 if they are not already coded as L0, L1 or L2. The milestone type for these

activities/milestones should be S- IPS. At a minimum, there should be 1 milestone/FY for each L4 in which activities are occurring. This will provide a meaningful data sampling of the detailed working schedules. This requirement does not apply to those L4 WBS elements that are entirely level of effort, eg Project Management. All milestone levels below level 3 are for use at the discretion of the STL. An inter-project link (IPL) is a special category of milestones used to link 2 or more tasks in separate subprojects. Inter-project links are used to emphasize critical interfaces between subprojects. These project-linking milestones should normally be identified as a level 9 MS if no other level has been assigned. An IPL milestone that has also been identified as a higher level milestone should be identified at its highest level. For example, a level 3 milestone for completion of the Target facility, 1.6, may trigger start of an activity in Operations, 1.10. This linking milestone should be identified as a Level 3 milestone. The inter-project link should also contain the characters IPL as the first characters in the Activity Description (e.g. IPL - Complete Linac Tunnel). A list of identified milestones will be contained in the Project Office Milestone Log.

Milestones representing completion of a deliverable will be identified, tracked, and used to evaluate progress of the project over time. The following table provides a sample of types of milestones and corresponding deliverables that should be incorporated in the schedule. Milestones listed must be included, where appropriate, on Funding Packages and in the Primavera schedule.

Group	Milestones Guidelines
R&D	R&D scope plan. Start R&D scope. Complete R&D scope.
Design	Title I start & complete Title II start. Title II mid point review. Title II complete Issue design criteria documents Design Reviews
Procurement	Long Lead and / or >$100K cost procurements Issue Specifications to procurement. RFP issue. Contract Award. Contract complete-procurement delivered
Fabrication	Receive design documentation. Start Fabrication Fabrication complete
Construction	Bid package Start Construction Construction complete BOD
Installation	Equipment received. Start Installation. Complete Installation.

Project Support	Project Start
	EIS ROD
	Cost / Schedule Baseline
	PSAR to Doe for approval
	PSAR approval.
	FSAR to DOE for approval.
	FSAR approval.
	Project complete.
Operations	Start Readiness Review.
	Readiness Review complete.
	Start Operations Procedures.
	Operations Procedures complete.
	Start Commissioning
	Beam Available
	Commissioning Complete

Building Area for Construction—A building activity code states the building or building area where equipment will reside at the SNS site. This information will help coordinate the completion of a building and the installation of technical equipment by allowing a sort on each code and will aid in the identification of equipment and activities by building. A sort on FE would filter activities associated with the Front End building and technical equipment that will be installed in the building. General oversight or PM activities may be coded NA as they are not specific to a building. The specific codes are listed below.

Building	Building Area
FE	Front End
LIN	LINAC Tunnel
KLY	Klystron Hall/HEBT Service Building
HEB	HEBT Tunnel
RIN	Storage Ring Tunnel
RTB	RTBT Tunnel
TAR	Target Building
RSB	Ring Service Building
RTS	RTBT Service Building
DUM	Dump Buildings
UTI	Utility Building
CLO	Central Lab and Office Building
CHL	Central Helium Liquidifier Building
RFB	Superconducting Rf Building
MSC	Site Bldg. and Structures
NA	Not Applicable

Optional Activity Codes—The following optional codes are set aside for use by the participating laboratories. The number of digits available for the code and the sequence in the dictionary are the only important considerations. The actual code can be unique to each Lab. For example, a division code of XA used at LBNL and the same code used at BNL would be mixed at the project group level. The correct sequence and space for the codes is identified in the SNS Activity Code Dictionary.

Special Reports (3 digits)
Reporting Manager (2 digits)
Division (2 digits)
Group (2 digits)

1.2.4 Other Codes

Calendars—Calendars are not activity codes, as defined by P3, but are required fields in the SNS schedule. Calendars are used to determine the correct number of working days available to each laboratory.

Calendars must be identified for each task. The default calendar is 1 if no other calendar is entered. The following calendar assignment must be used. Each laboratory is expected to develop a unique calendar that will be consolidated and entered by the Project Office.

AE/CM	1
ANL	2
LBNL	3
BNL	4
LANL	5
JLAB	9
ORNL	6
ORNL without holidays	7
Seven-day week w/o holidays	8

Resource Codes—Resource codes should be assigned to all activities in the current FY on which earned value is calculated. In the out-years, activities should be resource loaded such that they reflect, at a summary level, the activities and costs for work not yet scheduled in detail. The resources should be those used when originally estimating the effort and are unique to each laboratory. Effort resources should be loaded in hours, material procurements, travel and supplies and expenses (S&E) should be loaded in dollars. The resources and rate library is stored in MPM.

1.2.5 Filter and Report Consistency

In order to retain the maximum number of specialized filters and reports after a schedule integration, each subproject has been allocated a numerical range in both Filters and Reports. Therefore, 10 filters/reports will be retained for each subproject. However, any filters or report identifiers outside the subproject range will be replaced with those that are assigned to the particular subproject.

Assigned Codes	Subproject
00-09	ORNL—OPS
10-19	ORNL—Controls
20-29	LBNL—Front End Systems
30-39	LANL—Linac Systems (Warm Linac)
40-49	JLAB—Linac Systems (Superconducting Linac)
50-59	BNL—Ring Systems
60-69	ORNL—Target Systems
70-79	ANL—Instrument Systems
80-89	ORNL and AE/CM—Conventional Facilities
90-94	ORNL—Project Office
95-99	Reserved for Project Controls

1.2.6 File Transfer and Maintenance

The following file structure on the SNS server will be used to integrate subproject schedules into a detailed project schedule. Each participating laboratory has a unique subdirectory on the server where a completed subproject schedule may be placed. This schedule will be copied into another subdirectory where the integration will be accomplished. Once the subproject schedules are integrated into a detailed schedule, corrections are made and the new detailed schedule is placed in another area from which the new schedule can be downloaded by the laboratory or read on line

The main directory on the SNS server used for schedule integration is SNS_SCHEDULE.

The subdirectory for uploading schedules to the Project Office is the ULSUB-PROJECTS

The folders within the ULSUB-PROJECT subdirectory are:

TARGET
FRONT END
RING
LINAC
CONVENTIONAL FACILITIES
CONTROLS
PRE-OPERATIONS
PROJECT MANAGEMENT
EXPER INSTR
JLAB
ASD

A copy of the detailed schedule, integrated and ready for download, will be placed in the DLSUB-PROJECTS directory in the following folders:

DLEXPER INSTR
DLTARGET
DLFRONT END
DLRING

DLLINAC
DLCONVENTIONAL FACILITIES
DLCONTROLS
DLPRE-OPERATIONS
DLPROJECT MANAGEMENT
DLJLAB
DLASD

1.2.7 Data Date

The software must use a data date when rescheduling. To maintain consistency between subprojects, the project office for schedule update will identify the data date. Data dates for monthly status updates will always be the first day of the next month.

APPENDIX D

REFERENCE LIST OF GOOD PRACTICE GUIDELINES AND LESSONS LEARNED

APPENDIX D. REFERENCE LIST OF GOOD PRACTICE GUIDELINES AND LESSONS LEARNED

1. DOE Order 4700.1, Project Management (no longer in effect)
2. Improving Project Management in the Department of Energy, National Academy Press, 1999
3. NIF Project Assessment and Lessons Learned, 1999
4. 12/97 SNS Project Management Workshop—Presentations by APS, RHIC, APT, Bfactory
5. DOE Good Practice Guides
   - GPG-FM-001 Project Management Overview
   - GPG-FM-002 Critical Decision Criteria
   - GPG-FM-005 Test and Evaluation
   - GPG-FM-006 Performance Analysis and Reporting
   - GPG-FM-007 Risk Analysis and Management
   - GPG-FM-008 Work Scope Planning
   - GPG-FM-009 Baseline Change Control
   - GPG-FM-010 Project Execution and Engineering Management Planning
   - GPG-FM-012 Configuration and Data Management
   - GPG-FM-014 Program/Project Relationships
   - GPG-FM-015 Project Reviews
   - GPG-FM-016 Baseline Development
   - GPG-FM-019 Project Budget Process
   - GPG-FM-020 Contracting Options/Acquisition Resource Planning/Application of Performance Measures
   - GPG-FM-022 Public Participation
   - GPG-FM-026 Project Closeout
   - GPG-FM-030 Prioritization
   - GPG-FM-001 Life-Cycle Cost, 1953 KB
6. U.S Department of Energy, Program and Project Management Practices, 8/14/00
7. DOE O 413.3, Program and Project Management for the Acquisition of Capital Assets
8. GAO Report to the Committee on Science, House of Representatives, National Ignition Facility, Management and Oversight Failures Caused Major Cost Overruns and Schedule Delays GAO/RCED-00-141, August 2000

APPENDIX E

EARNED VALUE TUTORIAL GUIDE

Appendix E. Earned Value Approach Tutorial

Introduction

The Earned Value Method was first developed over 30 years ago by the United States Department of Defense to reduce risks of project cost growth. The Department of Defense refers to it as the Cost/Schedule Control Systems Criteria. The method is an early warning project management tool that enables Project Managers to identify and control problems before they become formidable. The process does not prevent cost overruns and schedule slippage. It allows the Project Manager to take necessary corrective action to change the trend.

Traditional cost and funding management looks at cost and schedule separately and sometimes makes wrong assumptions from the data. A project may appear to be on schedule and under budget when it is actually over budget and/or behind schedule. The Earned Value method is an enhancement over traditional accounting progress measures. Older methods focus on planned accomplishment (expenditures) and actual costs. Earned Value goes one step further and examines actual accomplishment. Actual accomplishment gives managers greater insight into potential risk areas. It also provides more accurate estimates for projected completion costs. With a clearer picture, managers can create risk mitigation plans based on the actual cost, schedule, and technical progress of the work.

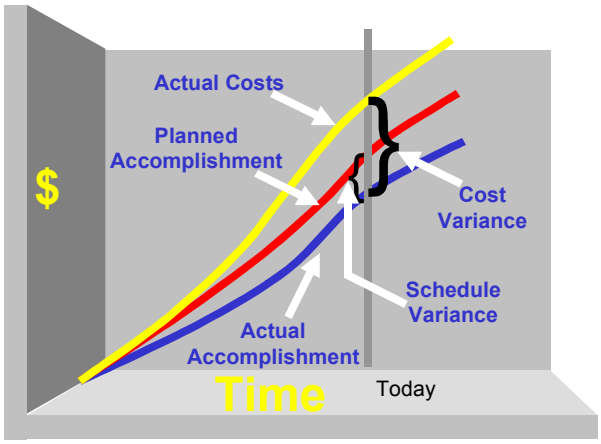
Early warning is important because cost overruns tend not to correct themselves over time. In fact, studies have shown they worsen, if not realized early. Research shows that projects that are over budget when only 15 percent finished usually post overruns at completion. Similarly, research shows that actual completion costs will not improve by more than 10% of the current percentage overrun. The reason cost overruns worsen in most cases is that managers don't know they have a cost overrun early enough in the project. The Earned Value method gives the early indicators that help alleviate this problem – indicators that can be used as early as the 15 to 20 percent point of completion.

Definition

Earned Value reflects the integration of cost, schedule, and technical work into one common view to establish a project plan. It uses progress against previously defined work plans to forecast such important concerns as estimated completion costs, finish dates, and the effectiveness of corrective action plans. Earned Value is the measurement of what you physically got for what you actually spent, or the value of work accomplished. "Earned Value" is a term that is often referred to as Budgeted Cost of Work Performed. Simply put, it is a program management technique that uses "work in progress" to indicate what will happen to work in the future.

In a graphical representation of the Earned Value approach, the cumulative Budgeted Cost of Work Scheduled or planned accomplishment is the baseline for the project. The Actual Cost of Work Performed is just the cost as a function of time. The Budgeted Cost of Work Performed or actual accomplishment known as Earned Value is a dollar representation of what it should have cost to do the work already accomplished. From this information, it is easy to calculate the cost variance and the schedule variance of the project at any point in time. It allows us to use cost and schedule together to determine where we are instead of using them separately and missing the total picture. Figure A-3 shows the graphical representation of the data collected using this process.

Figure A-3. Data Needed for Earned Value Determination



Assessing Project Performance

The primary performance measures for the Earned Value method are the Cost Performance Index and the Schedule Performance Index. The Cost Performance Index is the ratio between Earned Value and actual costs while the Scheduled Performance Index is the ratio between Earned Value and planned work (budgeted costs). The formulas are shown below:

Cost Performance Index (CPI) = Earned Value/Actual Cost = BCWP/ACWP

Schedule Performance Index (SPI) = Earned Value/Planned Value = BCWP/BCWS

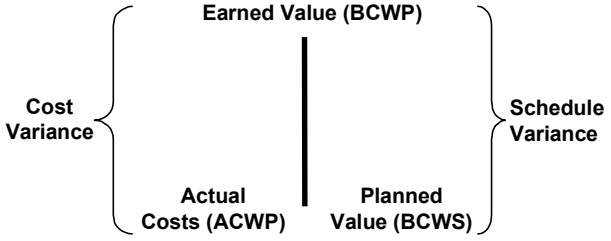
If CPI = 1.0, then performance is on target.

If CPI > 1.0, then performance is exceptional.

If CPI < 1.0, then performance is substandard.

The same is true for Schedule Performance Index. Note that a Cost Performance Index of 0.85 means that for every dollar that was spent, only $0.85 in physical work was accomplished. A Schedule Performance Index of 0.90 means that for every dollar of physical work the project had planned to accomplish, only $0.90 was completed.

There are other factors that can be used to assess the performance of projects. These measures include Cost Variance, Schedule Variance, Percent Variance, Variance at Completion, and To Complete Performance Index. In many cases, the Cost and Schedule Variances are more meaningful to upper management who may not fully understand the indices. Definitions of terms and calculations are shown in Attachment 8.1. An illustration of cost and schedule variance is seen in Figure A-4 and in the following illustration.



Estimating Future Cost and Completion Dates

Because we have cost and schedule indices, we can then estimate the approximate cost at completion of the project and the time that it will take to complete it. For cost, we can calculate the Estimate at Completion within a given range of values. The calculations are as follows:

Estimate at Completion (EAC) $_{min}$ = (BAC – BCWP) + ACWP

Estimate at Completion (EAC) $_{max}$ = ((BAC – BCWP) / (CPI x SPI)) + ACWP

(Note that there are a number of different Estimates at Completion equations that can be used. See Attachment 8.1 for further explanation.)

The estimated time to complete the project can also be calculated by taking the projects planned completion in months and dividing it by the Scheduled Performance Index. Therefore:

Estimated Time to Complete (ETC) = Planned Completion / SPI

Monitoring Performance

Performance must be monitored at the lowest level of the Work Breakdown Structure where distinct work packages are created, budgeted, and scheduled. This gives the greatest confidence in determining specific deliverables and the ability to estimate the Earned Value for work performed. However, the final indices and measures are reported overall as a roll-up of the Work Breakdown Structure tasks.

The schedule of tasks and a method for measuring the use of resources are needed in order to calculate Earned Value. The metrics used can vary and should be determined based on availability of data, type of project task, and appropriateness. The various types of metrics include:

1. Weighted Milestones

Weighted milestones work well for work packages that are three or more months in length. Each milestone is given a budget value that will be earned on completion of the event. Thus, the total work package budget is divided up based on a weighted value assigned to each milestone, as shown in the following table.

	Item	Jan	Feb	Mar	Apr	May	Jun	BAC
Weighted Milestones	Planned	30	70	70	30	30		230
	Earned							
	Actual							

This method is a preferred one used in performance measurement, but it is also the most difficult to plan and administer. Why? Because it requires a close working relationship between the work package managers, scheduling people, and resource estimating people in order to establish meaningful milestones.

2. Fixed Formula by Task: 0/100; 25/75; 50/50

This method is perhaps the best one when applied to short-span work packages whose duration is only one, two, or possibly even three months. For instance, 0/100 method is best applied to those work packages that start and end within one accounting month. Nothing is earned when the task begins, but 100 percent of the budget is earned when completed.

Similarly, the 50/50 technique is used for work packages whose duration usually spans two accounting months. Fifty percent of the planned value is earned when the task starts and the balance is earned when it ends.

Cost account managers may use other variations of this method to set in advance the percentage values they wish to use, e.g., 25/75, 20/80, etc.

3. Percent Complete

Typically this method relies strictly on one's "subjective" estimate of the percentage of work completed and is provided by the individual in charge of the work package. However, written guidelines have been used to assist in assigning a percent complete value based on completed work, e.g., drawings issued, lines of software code tested, parts received, etc.

The percent complete method is the easiest to administer, but is most subject to individual bias and optimistic figures. One technique used to address the optimism factor is to set a maximum ceiling amount for any work package until it is 100 percent complete. For example, with an 80 percent ceiling, a work package may only earn up to 80 percent of the manager's estimate until the task is 100 percent complete.

Subjective estimates only work well if checks and balances exist to challenge poor or overly optimistic estimates.

4. Equivalent Completed Units

This approach places a planned value for each unit completed and is used for managing repetitive-type work. For instance, a project's goal is to construct ten homes valued at $100,000 per unit. Costs for each site excavation and unit foundation are estimated to be ten percent of each house. At the end of the first month, the project completed excavation and unit foundations for all ten homes. Therefore, the Earned Value for the first month would be $100,000, or the equivalent of one home.

Typically laboratory projects are not repetitive enough for this approach to be useful.

5. Level of Effort … NOT Recommended!

Level of effort activities are those driven by time vs. task (e.g., procurement, contract administration, budgeting, etc.). The principal problem with level of effort activities is that whatever is authorized as the planned value actually becomes the Earned Value regardless of what actual work takes place. In other words, Earned Value always matches planned value. The use of level of effort methods is not recommended.

In short, one or more of the first three methods should be used for the Deputy Assistant Secretary for Research, Development and Simulation, DP-10 projects when figuring Earned Value for discrete work packages.

Limitations on Earned Value Method

Earned Value measurement works well with direct labor and corresponding indirect labor rates applied to direct labor costs. However, with materials, subcontracts, and other direct costs whose charges may take time to arrive, the problem arises with the early or delayed recording of actual costs. This will obviously affect the Earned Value performance being measured! Some care is required to compare comparable costs; the results will not be comparable if there is a significant difference between project reporting times and financial accounting times.

References

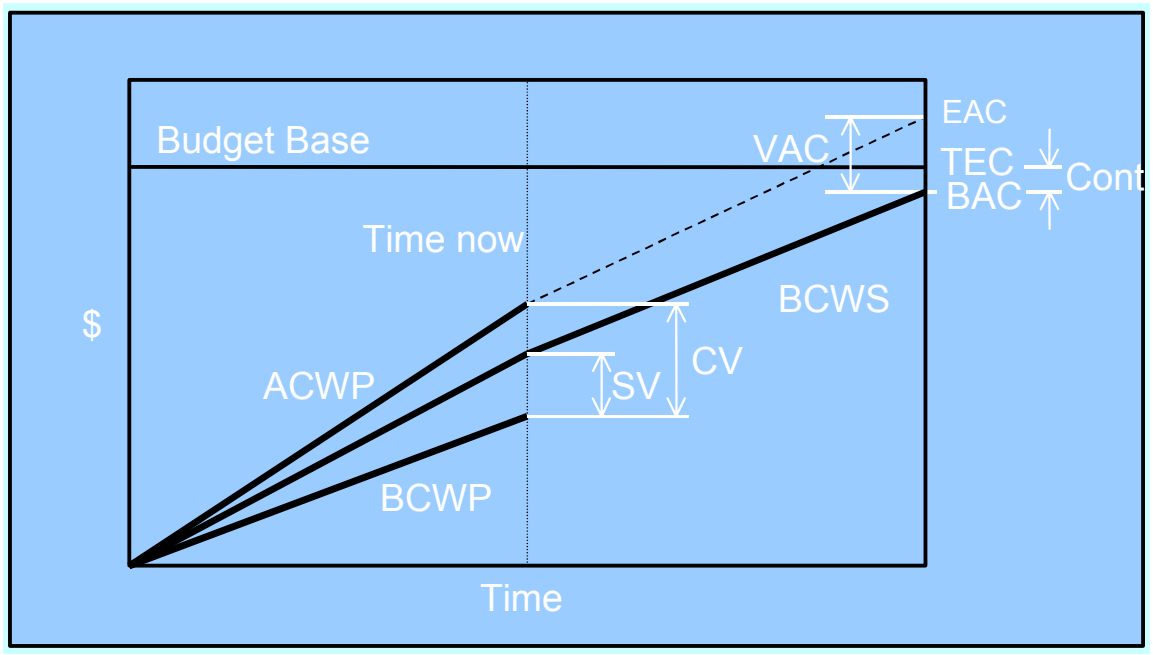
American Graduate University, (1999), Performance Measurement and Analysis (Performance Measurement Using Earned Value Concepts*);* Technical Program Management Course.

CMS Information Services, Inc. (March 1999), Web Page

Hess, Michael M. (September 1998). Earned Value Project Management: What is it? And how can we effectively use it? White Paper, Sandia National Laboratories

Kerzner, Harold. (1998), Project Management: A Systems Approach to Planning, Scheduling, and Controlling.

Figure A-4. Performance Metrics



APPENDIX F

EARNED VALUE APPLICATION EXAMPLES

APPENDIX F. EARNED VALUE APPLICATION EXAMPLES

6 Months Tracking a Task

Items Agreed upon as measures each month **(The Plan)**

- January
  7 drawings and associated engineering are in this task; 5 to be completed at the end of 1st month and others at the end of second month. Manhours for 1st 5 total same as other 2 over 2 months. Dollar value of first 5 is $100,000 total and same for the other 2. (Using this milestone approach credit is only received for completed drawings, etc.)
- February
  In addition to completing the 2 drawings, 5 specs will be prepared at a cost of $75,000 , all of equal cost.
- March
  The procurement will be initiated, negotiated and concluded. Cost $50,000.
- April
  Fabrication will begin and a progress payment of $150,000 is planned. internal management cost is budgeted at $10,000 per month for 3 months.
- May
  Another progress payment is planned of $ $200,000. The quality staff must perform inspections and tests at a cost of $60,000 at the vendor's plant.
- June
  The task is to be completed with the installation and final testing of the unit at a cost of $110,000.

ACWP

- End January
  4 of the 5 scheduled are complete at a cost of $100,000 (the total budget for the 5) and 75% of the budget for the other 2 has been expended. Therefore, $175,000 has been expended.
- End February
  The 5th of the basic drawings is completed and only 1 of the other 2. 3 of the 5 specs are complete, but the other 2 are late since they are dependent on the drawing which is not yet complete. The complete budget for the drawings has been expended plus $25,000 and funds are needed for completing the last drawing. The specs are on budget for those completed, $45,000. Therefore, $95,000 was expended in February. (Note 1 drawing and 2 specs are behind schedule.)
- End March
  The procurement could not be completed before the end of the month since the critical drawing and the last 2 specs were not completed until the 20th of the month. The cost for completing the drawing was an additional $25,000 over budget and the specs were completed within budget of $30,000. $30,000 of the procurement budget was expended. Therefore, $85,000 was expended in March.
- End April
  The procurement was completed on the 10th of April and contractor began work. On the 25th he pointed out that there are errors in the design and he submitted a change request including an increase to the $350,000 contract of $50,000. He submitted his first progress payment of $150,000. Management costs totaled $10,000 as planned. The total expended costs for April are $180,000.
- End May

The contractor completed the contract on schedule at a total approved cost of $400,000; $250,000 in May. The errors caused an additional $20,000 in design costs. The inspection and testing were completed on schedule and within the $60,000 budget. The ACWP for May then is $330,000.

- End June
  The installation and final testing were completed within budget and schedule. The ACWP therefore was $110,000 for June.

BCWP for Milestone Method

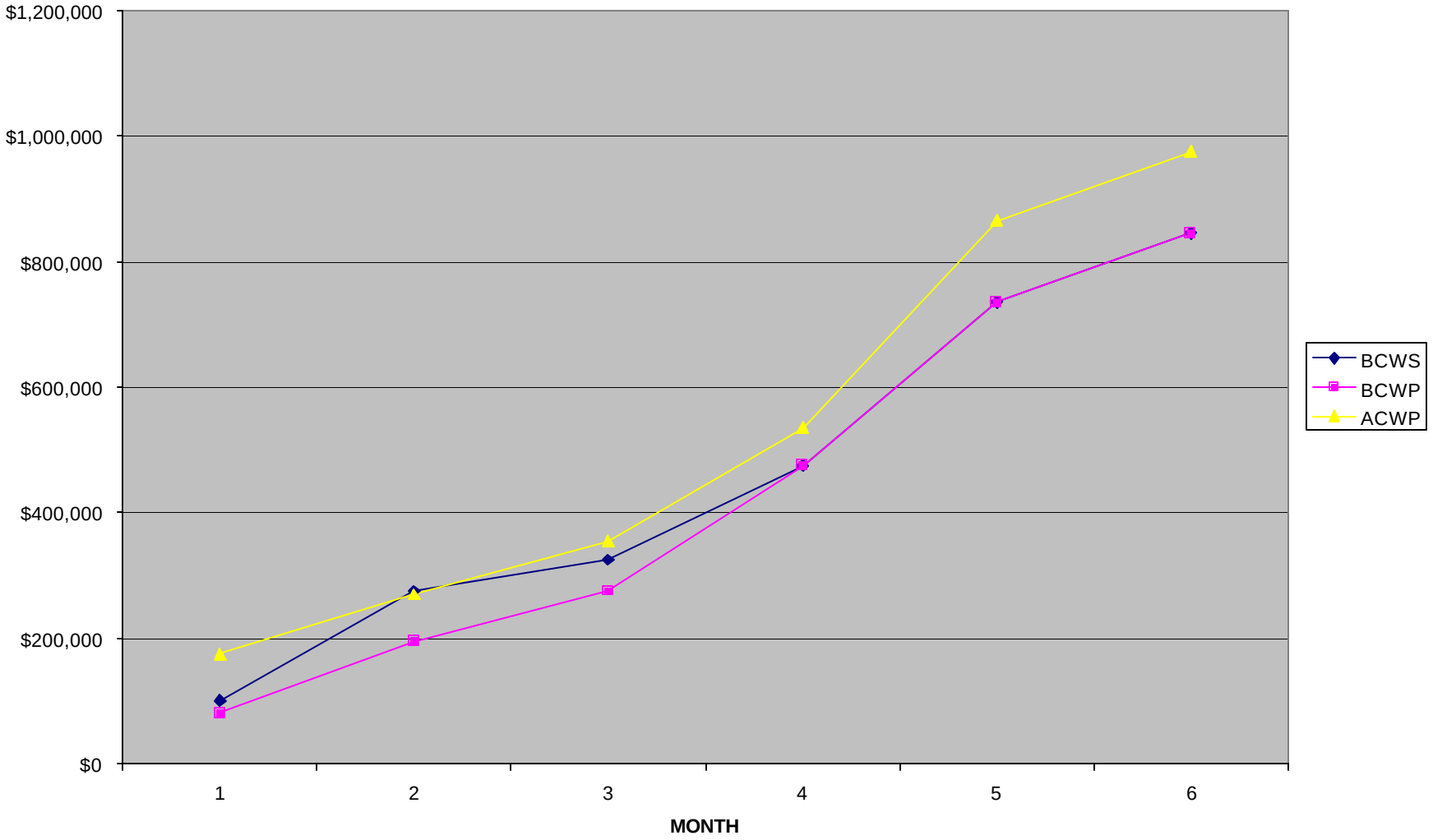
- End January
  Only the 4 completed drawings have earned value, i.e., $80,000.
- End February
  1 basic drawing was completed (late) and 1 other for a total of $70,000 earned value/BCWP. 3 specs were completed with a BCWP of $45,000.
- End March
  1 drawing with a earned value of $50,000 and 2 specs with an earned value of $30,000 were completed with a BCWP of $80,000 for the month.
- End April
  The procurement was completed with BWCP of $50,000 and the progress payment of $150,000 for a total BWCP of $200,000.
- End May
  The contract was completed and the progress payment of $ 200,000 (does not include $50,000 adder for error correction) is credited as BWCP. The inspection and testing $60,000 is credited as BWCP. Therefore, the total BWCP for May is $260,000.
- End June
  The installation and final testing was completed on budget and the BWCP for June is $110,000.

BCWP – PERCENT COMPLETE METHOD

Now consider a case where we use a percent complete approach for measuring performance. The tasks to be completed are as stated above in the section **ACWP**. Now we will consider the revised BCWP reported for this case.

- End January
  $175,000 has been expended and is reported as BCWP and the ACWP is the same. BCWS is $100,000. Therefore it looks like we are ahead of schedule and on budget, i.e., SV is 0 and CV is positive.
- End February
  An additional $95,000 is expended and the cumulative ACWP is $5,000 less than the BCWP and the BCWS. The cumulative SV is still 0 and the CV is still positive.
- End March
  An additional $85,000 is expended in March and the cumulative CV has now gone negative (-$30,000). It now for the first time becomes apparent that the cost is exceeding the plan and there are problems.

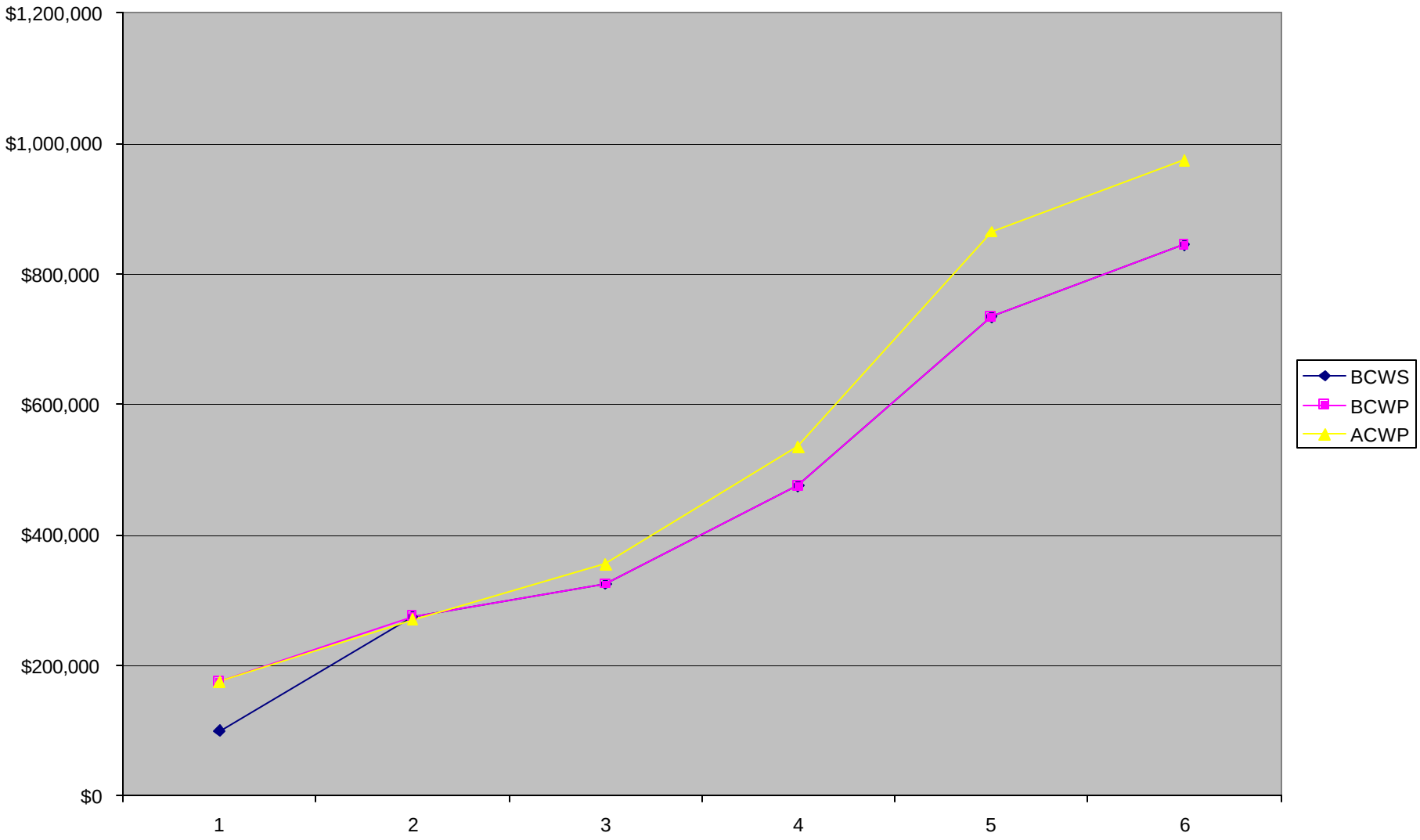
THIS IS WHY IT IS MORE DESIRABLE TO USE TRULY MEASURABLE QUANTITIES FOR PERFORMANCE MEASUREMENT THAT JUST PERCENT COMPLETE. THE NEGATIVE VARIANCES BECOME VISIBLE SOONER.



Trends utilizing milestone method.

		Current Month					Cumulative								CUMULATIVE	
TASK	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV		SV%	CV%		SV%	CV%
January	$100,000	$80,000	$175,000	($20,000)	($95,000)	$100,000	$80,000	$175,000	($20,000)	($95,000)		-20	-118.75		-20	-118.75
February	$175,000	$115,000	$95,000	($60,000)	$20,000	$275,000	$195,000	$270,000	($80,000)	($75,000)		-34.29	17.39		-29.09	-38.46
March	$50,000	$80,000	$85,000	$30,000	($5,000)	$325,000	$275,000	$355,000	($50,000)	($80,000)		60	-6.25		-15.38	-29.09
April	$150,000	$200,000	$180,000	$50,000	$20,000	$475,000	$475,000	$535,000	$0	($60,000)		33.33	10		0	-12.63
May	$260,000	$260,000	$330,000	$0	($70,000)	$735,000	$735,000	$865,000	$0	($130,000)		0	-26.92		0	-17.69
June	$110,000	$110,000	$110,000	$0	$0	$845,000	$845,000	$975,000	$0	($130,000)		0	0		0	-15.38

Data utilizing milestone method.



Trends utilizing % completed method.

		Current Month					Cumulative								CUMULATIVE	
TASK	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV			SV%	CV%	SV%	CV%
January	$100,000	$175,000	$175,000	$75,000	$0	$100,000	$175,000	$175,000	$75,000	$0			75	0	75	0
February	$175,000	$100,000	$95,000	($75,000)	$5,000	$275,000	$275,000	$270,000	$0	$5,000			-42.86	5	0	1.82
March	$50,000	$50,000	$85,000	$0	($35,000)	$325,000	$325,000	$355,000	$0	($30,000)			0	-70	0	-9.23
April	$150,000	$150,000	$180,000	$0	($30,000)	$475,000	$475,000	$535,000	$0	($60,000)			0	-20	0	-12.63
May	$260,000	$260,000	$330,000	$0	($70,000)	$735,000	$735,000	$865,000	$0	($130,000)			0	-26.92	0	-17.69
June	$110,000	$110,000	$110,000	$0	$0	$845,000	$845,000	$975,000	$0	($130,000)			0	0	0	-15.38

Data utilizing % completed method.

APPENDIX G

FINANCIAL SYSTEMS

APPENDIX G. FINANCIAL SYSTEMS

1.1 FINANCIAL MANAGEMENT

1.1.1 SNS Business Office

The Business Manager is responsible for project financial management and reports directly to the Spallation Neutron Source Project Director. ORNL's accounting and reporting systems will be used to collect and report costs and commitments. The Business Manager and the finance staff will interface with the ORNL Finance and Budget Division as needed to address project accounting requirements. The Business Manager will also interface directly with Accounting, Property and Materials Management, Tax Administration Office, legal staff, DOE-OR, and participating laboratory financial staff, etc., in order to address business and project requirements. The SNS Project Business Manager is responsible for maintaining the official financial records for the ORNL portion of the project.

The Business Manager will design the overall Project Office account structure. The Project Office accounting strategy will be based on the following principles: (1) accounts are consistent with the WBS and the type of funds authorized; (2) Project Office laboratory cost collection accounts are established at WBS level 2 for the line item portion of the project, and at WBS level 3 for the R&D portion for costs from partner laboratories; (3) WBS numbers are included in account descriptions; and (4) SNS Project accounts/work orders will be used exclusively to collect project costs (i.e., no funds will be allocated directly to other internal ORNL divisions). Participating laboratory accounting requirements are covered in a subsequent section.

The SNS Project Finance Officers will open all Oak Ridge SNS Project accounts/work orders. As a general rule, all accounts/work orders opened will be assigned a budget consistent with the approved funding package. When a budget is not assigned, the SNS Finance Officers will apprise the Business Manager.

The SNS Finance Officers will prepare the necessary documentation (e.g., request for funds form) for obtaining the ORNL capital accounting manager's approval for capital equipment and line item construction accounts. Approved accounts must be consistent with the SNS Project account structure.

All requested cost adjustments/transfers will be reviewed and approved by the Finance Officers. Cost adjustments will be properly documented and a file maintained in the Business Office.

The SNS Business Office will prepare a monthly financial summary report that consolidates all laboratory and AE/CM financial status reports. Financial status reports are discussed in more detail under the laboratory accounting and reporting section. This financial summary report will be distributed to Project Office managers monthly.

The SNS Business Office will compare reported cost by the ORNL accounting system and other laboratory SNS financial status reports (i.e., laboratory transfer vouchers). A monthly reconciliation report will be prepared. A copy of the FSR will be provided monthly to the Project Controls Group to ensure consistency is maintained between the Financial and Project Control Systems.

1.1.2 Oak Ridge Projects

The SNS Business Office will work with the Senior Team Leaders to establish an account/work order structure consistent with the overall project accounting strategy. Before an account/work order is opened, the SNS Business Office will ensure account numbers, descriptions, and WBS levels are consistent with the accounting strategy.

1.1.3 Laboratory Accounting and Reporting

Each participating laboratory will be responsible for establishing cost accounts consistent with the WBS. At a minimum, cost accounts will be established at the fourth level of the WBS. Accounts will be structured to ensure operating, capital equipment, and line items funds are not combined or commingled. The SNS Project will be subject to the normal and customary business rules of the laboratories, consistent with the SNS laboratory MOA, the DOE field office MOA, and any special financial provisions approved for the SNS Project. Because of the possibility that the official laboratory accounting system and SNS Project controls system could report different amounts of cost, it is the responsibility of each laboratory business management team to reconcile monthly the project controls system to the official laboratory accounting system.

The SNS Project Office will allocate BA based on approved funding packages. Even though the funding package will reflect the budget for the entire fiscal year, the SNS Project Office may elect to incrementally fund the work. Each laboratory is responsible for controlling expenditures and commitments so that BA authorized through the official financial system is not exceeded. A monthly financial status report will be submitted to the Business Manager by each participating laboratory seven work days after the close of its business month.

Example
Oak Ridge SNS Project Financial Status Report
(Target Systems)
Cost Through December 31, 1999
FY 1999
Actual Dollars

WBS NO.	WBS DESCRIPTION	New BA Plan	New BA Authorized	Beginning Uncosted	Total Authorized	Current Month Cost	Cumulative Cost	Outstanding Commitments	Balance
1.6.1	Target Assemblies	5,000,000	2,500,000	100,000	2,600,000	150,000	300,000	500,000	1,800,000
1.6.2	Moderator Systems	200,000	1,200,000	88,000	1,288,000	125,000	250,000	250,000	788,000
1.6.3	Reflector Assemblies	1,000,000	750,000	60,000	810,000	50,000	105,000	605,000	100,000
1.6.4	Vessel Systems	500,000	300,000	114,000	414,000	45,000	90,000	754,000	(430,000)
1.6.5	Target Station Shielding	250,000	100,000	(45,000)	55,000	10,000	50,000	152,000	(147,000)
1.6.6	Target Utility Systems	3,000,000	1,200,000	75,000	1,275,000	100,000	245,000	65,578	964,422
1.6.7	Remote Handling Systems	4,500,000	3,000,000	-	3,000,000	125,000	650,000	152,150	2,197,850
1.6.8	Beam Dumps	2,500,500	1,250,500	-	1,250,500	215,000	300,000	354,125	596,375
1.6.9	Controls	1,250,000	800,000	109,000	909,000	150,000	185,000	119,325	604,675
1.6.10	Technical Support	750,000	450,000	50,000	500,000	105,000	115,000	-	385,000
	Total	**18,950,500**	**11,550,500**	**551,000**	**12,101,500**	**1,075,000**	**2,290,000**	**2,952,178**	**6,859,322**

Oak Ridge SNS Project Financial Status Report (Target Systems)

The report will be based on the third level of the WBS unless otherwise directed and will include official cost and commitment data, consistent with data reported in the DOE Management Analysis Reporting System (MARS). The new BA plan column reflects the budgets in the approved funding packages, whereas the new BA authorization column includes only current year BA authorized in the official financial system. The beginning uncosted balance column reflects carryover funds.

The project team at each participating laboratory and at the AE/CM are responsible for maintaining official cost records for their activities, and shall request permission from the SNS Project Office before disposing of such records. Maintenance of these records in the same system that is used for drawings, specifications, and other project documents is acceptable.

1.2 ACCOUNTING ACCRUALS

For the earned value project measurement system to be effective, it is essential that cost be recorded in the official accounting system in the same period that work is performed. Recognizing that subcontractor billings normally lag the actual period of performance, laboratories will need to accrue estimated subcontractor costs. Accruals will consist of the cost of work completed, but not yet billed, by subcontractors through the end of the month.

Accruals should be based upon information submitted by subcontractors in accordance with the terms of the subcontract. While documentation in the form of subcontractor invoices is the best support for cost accruals, in the absence of such documentation, other alternatives may be used (e.g., other project information submitted by the subcontractor and input from project managers). As with all documentation that is entered into an official laboratory accounting system, the documentation or basis for estimating cost for accrual purposes must be assessed for adequacy and reasonableness of estimates. Cost accounting accruals should be recorded exclusively in the official laboratory accounting system and should flow to the project controls system. An accrual directly into the project controls system that bypasses the official accounting system will result in an unwanted and undesirable cost difference between the official laboratory accounting system and the project controls system. All financial information used to manage the SNS Project is required to originate in the official laboratory accounting system.

1.3 ANNUAL BUDGET REQUEST TO DOE

DOE funds the SNS Project through the federal appropriations process. The SNS Project Office prepares an annual budget request based on project requirements and submits it to DOE. The DOE field work proposal (FWP) format is used to request funds for the R&D and operations portions of the project. The R&D and operations phases are funded with operating expense and capital equipment funds. Capital equipment funds are used to purchase capital equipment not related to construction.

DOE's long form project data sheet is used to request funds for the SNS construction phase of the project. The project data sheet contains the description, justification, and cost and schedule baseline data necessary to support the project. While the budget requests for the R&D and operations phases are separate and distinct and do not overlap, FWP data referenced in the project data sheet will be consistent with the SNS FWP requests. The Project Office will prepare all budget information with input from participating laboratories and will be responsible for submitting all formal budget requests to DOE.

If funds authorized by Congress and the President do not support the cost and schedule baselines, the schedule will be revised to adjust activities so that resource requirements will fit within funding constraints. DOE will be informed of future funding requirements to complete the work, and subsequent budget requests will reflect the new requirements. Funding constraints that impact either the TPC or construction schedule will be documented and considered a "directed change" under the configuration control system.

1.4 COST ACCOUNTS

SNS Project accounts will collect costs for labor, effort, travel, materials, subcontracts, organizational burden, overhead, etc. Each account will have sufficient cost detail so that variance analysis and earned value calculations can be readily made. Distributing or allocating accounts that have the effect of combining or commingling direct project costs (i.e., cost elements lose their identity) and that allocate cost on a percentage basis, or some other basis, are prohibited. This does not apply, however, to legitimate laboratory overhead accounts or to cost and service centers, when used to collect labor and fringe costs and to charge out direct effort at an hourly rate.

1.5 CAPITAL ACCOUNTING AND PROPERTY MANAGEMENT

It is the responsibility of each participating laboratory Senior Team Leader to properly manage equipment and materials purchased with SNS Project funds. Materials and equipment that are purchased for R&D, fabrication, testing and commissioning, and operation of SNS systems or components shall be properly stored and segregated to ensure their integrity and availability for use at the SNS site. The property management rules for each laboratory will be followed. The process for transfer of the SNS property and components from partner labs and the receipt of those items from partner labs and partner lab vendors will be detailed in a separate document.

1.6 LABORATORY OVERHEAD

Each laboratory has a distinct set of overhead rates and overhead application rules. DOE-OR has approved special ORNL overhead rates for the SNS Project in compliance with the Cost Accounting Standards. The cost accounting standards are based on the "matching" accounting principle. The Oak Ridge special overhead rate was derived by determining the causal/beneficial relationship of each overhead activity to the SNS Project. Lawrence Berkley National Laboratory (LBNL), Los Alamos National Laboratory (LANL), and Brookhaven National Laboratory (BNL), and Argonne National Laboratory (ANL) include, as a part of their normal overhead rate structure, special rates for line item construction work. The line item portion of the SNS Project will be charged the appropriate special overhead rates. At LBNL, LANL, and BNL, the R&D and operations portions of the project will receive the same overhead treatment normally applied to similar work. Jefferson Laboratory does not have special overhead rates. All of the laboratories publish general overhead rates annually and make adjustments through the year as needed.

Overhead rates, accounting systems, and business rules have the potential to change over time. Because of the potential impact to the SNS Project, the Business Manager will survey each laboratory at the beginning of each fiscal year to determine overhead rates and overhead application rules. Each Senior Team Leader is required to notify the Business Manager when any of the following occurs during a fiscal year: (1) overhead rates change, (2) overhead application rules change, or (3) a new accounting system is being planned.

When overhead rates increase or overhead application rules change, the Business Manager will inform the Project Director. If changes to overhead rates or overhead application rules increase the BAC, a project change request will be submitted to the appropriate Configuration Control Board (CCB).

1.7 CHART OF ACCOUNTS

The Chart of Accounts represents all of the laboratory accounts to be used by the project to collect cost. The Chart of Accounts may be updated as required to address the normal dynamics of a line item construction project. When more than one laboratory performs work associated with the same work scope, separate accounts will be established at the Project Office to collect the cost transferred from each laboratory.

Both the official laboratory accounting system and the SNS Project controls system are based on the chart of accounts. Each laboratory is required to consider the type of funds authorized by the Project Office when designing and updating the Chart of Accounts. Project accounts are prohibited from having more than one type of funding (i.e., operating expense, capital equipment, line item construction).

APPENDIX H

PROCUREMENT OPERATIONS

APPENDIX H. PROCUREMENT OPERATIONS

1.1 INTRODUCTION

This appendix describes the procurement framework for use on the SNS Project. Key topics addressed include procurement management, advance procurement plans (APPs), and overall guidelines for accomplishing procurements on the SNS project. Detailed procurement practices and operations are described in the SNS Procurement procedures. Material in this chapter may be updated if project requirements change.

1.2 PROCUREMENT PLANNING AND REPORTING

Each laboratory is responsible for planning, tracking, and executing all procurements required to complete a subproject. Work package managers are responsible for general coordination with all of the organizations involved in procurement planning to ensure that (1) procurement requirements are properly defined; (2) major procurements are included in the project schedule, to identify required delivery dates and to allow for adequate lead-time for all phases of the project; and (3) procurements are budgeting properly such that the performance measurement baseline (PMB) and project baseline are consistent with the procurement requirements and schedule. Procurement planning is important to ensure that current year funds are allocated consistent with project requirements. The SNS Advance Procurement Plan (APP) is used as a benchmark to measure progress in executing planned procurement actions. Amounts included in the SNS Procurement Plan will have a strong influence on the amount of BA included in the work package.

While the format of the APP addresses only procurements at WBS level three, participating laboratories are required to maintain a Procurement Schedule Status Report (PSSR). The PSSR is a real-time WEB based system that is to be updated as data becomes available. The procurement plan is based on information included in the PSSR. Laboratories and the architect-engineer construction management (AE/CM) team use the PSSR to plan and track major procurements. The PSSR includes procurements that are greater than $100,000, or less than $100,000 if a procurement item is on the critical path, has a long lead time or includes critical subcontractor. The report identifies the WBS number, laboratory, APP, a brief description of the item, buyer, , critical path identification (yes, no), procurement start date, procuremnet type (service, construction, design, etc.), RFP projected release date, RFP actual release date, projected award date, actual award date, projected completion date, actual completion date, baseline estimate procurement estimate, total award value , obligated amount, subcontract number, vendor identification , vendor classification/location, and procurement strategy. RFP projected release dates, projected award dates, and projected completion dates are required to be milestones in the project schedule. Procurement representatives from participating laboratories are required to maintain the PSSR.

Each Senior Team Leader will address planned procurement methods and strategy for his segment of the project. It is possible to use more than one strategy on a particular procurement action. For example, a subcontract may be a cost type and may also be funded incrementally. Detailed procurement planning will include potential fallback positions in case a vendor is unavailable or fails to perform as expected.

Procurement strategies include:

-
- Subcontract/Purchase Order
- Basic Ordering Agreement (BOA)/Outline Agreement
- Task Order
- Fixed-Price

- Cost-Reimbursement
- Incrementally-Funded
- Subcontract/Purchase Order with Options

Two of the most common types of subcontracting methods are fixed-price and cost-reimbursement. Cost-reimbursement subcontracts are commonly used in the procurement of R&D or other complex work where performance uncertainties make it difficult to estimate the cost of performance in advance. Cost-reimbursement subcontracts provide the minimum incentive for the subcontractor to control costs and impose the maximum obligation on the appropriate SNS Senior Team Leader to monitor the subcontractor's performance and costs. Fixed-price subcontracts place the responsibility for performance within the stated price on the subcontractor. It is the SNS procurement strategy to use fixed-price procurements at every opportunity.

As a part of contractual requirements for major cost reimbursement procurements (>$500,000), each vendor will be required to report monthly on the work performed and cost incurred. When an item is on the critical path or a critical subcontractor is performing a complex piece of work, even though it may not be considered a major procurement item, cost performance reporting requirements will be imposed on vendors. The lead engineer will work with the procurement organization to ensure appropriate requirements are included in procurement packages.

Procurement planning information is required to be available to the SNS Project Office by September 15th prior to each new fiscal year. The procurement plan is required to be updated within 30 days after revised funding packages have been approved. Adjustments to the procurement plan can be made to future month estimates, but retroactive or current month adjustments are prohibited. Each laboratory is required to maintain historical procurement information for the life of the project.

1.3 PROCUREMENT MANAGEMENT

1.3.1 SNS Project Office

The SNS Procurement Director is responsible for SNS procurement activity and reports directly to the SNS Deputy Project Director. ORNL's business infrastructure systems will be used as much as practical to support procurement operations. The SNS Procurement Director will interface with ORNL Procurement colleagues as needed to address project procurement requirements. The Procurement Director will also interface directly with ORNL Procurement, ORNL Property and Materials Management, ORNL Tax Administration Office, ORNL Office of General Counsel, DOE-ORO, and participating laboratory financial staff, etc., in order to address SNS procurement requirements. The SNS Procurement Director is responsible for maintaining the official procurement records for the ORNL portion of the project.

The Procurement Director will develop and direct the overall Project Office procurement strategy as approved by the Deputy Project Director in support of operations. The Project Office procurement strategy will be based on the following principles: (1) timely support will be provided to meet schedule requirements, (2) cost-effective, efficient, best business practices will be used at every opportunity, (3) partner procurement operations with the opportunity to seek support and use SNS practices to meet schedule requirements, (4) innovative procurement concepts will be employed whenever necessary to improve the quality of acquisition support to project personnel.

1.3.2 Laboratory Procurement Reporting

Each participating laboratory will be responsible for entering procurement information, as it becomes available, into the SNS Procurement System Status Report (PSSR). Critical path, as well as all procurements over $100,000 will be tracked through this system.

APPENDIX I

RESPONSIBILITY MATRIX

RESPONSIBILITY MATRIX for KEY PROCESSES and FUNCTIONS

Process or Responsibility Area	Deputy Project Director	Project Controls Mgr.	Baseline Change Control Manager	Business Mgr.	Division Director	Senior Team Leader	Remarks
PROCESSES/FUNCTIONS							
A. Cost Estimates	**A**	**IT/T**	**S**	**S**	**R/A**	**I/R/P/T/ D**	
B. Schedules	**A**	**IT/T**	**S**	**S**	**R/A**	**I/R/P/T/ D**	
C. Annual Funding Packages	**A**	**I/R/IT/ L**	**S**	**S/R/ L**	**R/A**	**P/D**	Prepared by participating laboratories with input from STL's. Project Director approves for submission to DOE.
D. Baseline Changes							
Level 0	**R**	**R**	**I**				Approved by DOE Acquisition Executive
Level 1	**R**	**R**	**I**				Approved by DOE Program Office (SC)
Level 2	**R**	**R**	**I**				Approved by DOE Project Office (ORO)
Level 3	**A**	**R**	**S**		**R**	**I/D**	
Level 4		**R**	**S**		**A**	**I/D**	
Level 5						**I/A/D**	
E. Performance Measures	**A/T**	**R/T/IT**	**S**	**S**	**R/T**	**I/R/D/T**	
F. Cost Performance Reports	**A**	**IT/P**	**S**	**S**	**R**	**D/P**	
G. Variance Analysis & Reporting	**R/T**	**IT/T**		**S**	**R/T**	**P/D/T**	

Process or Responsibility Area	Deputy Project Director	Project Controls Mgr.		Business Mgr.	Division Director	Senior Team Leader	Remarks
H. Project Reviews	**R**	**I/R**	**S**	**S**	**R**	**P/D**	
RESPONSIBILITIES							
J. SNS Project Controls System policy and process definition	**S**	**L**	**S**	**S**	**S**	**S**	
K. Implementation of Project Controls Systems	**S**	**IT/L**	**S**	**S**	**S**	**L**	
L. Periodic sampling validation reviews of partner lab source information & processes	**S**	**L**	**S**	**S**	**S**	**S**	
M. Training to assure a common process is understood and implemented	**S**	**L**	**S**	**S**	**S**	**S**	
N. Refinement of Project Control processes as project progresses through various phases	**S**	**L**	**S**	**S**	**S**	**S**	

PROCESS/FUNCTIONS
A = Approves
I = Initiates
R = Reviews & Recommends
P = Prepares
T = Tracks Progress
D = Provides Data
IT = Integrates

RESPONSIBILITIES
L = Lead Responsibility
S = Support Responsibility

APPENDIX J

PROJECT MANAGEMENT REPORTS

APPENDIX J. PROJECT MANAGEMENT REPORTS

Performance Area	Report Title	Originator	Frequency	Description
Work scope/cost/schedule/variance analyses	Monthly Progress Report	STLs	Monthly	At WBS Level 2/3 (by subproject), narrative accomplishments and issues; variance analysis reports with corrective actions, critical path, milestones status; cost and schedule earned value for current period and cumulative trends. CPI and SPI cumulative trends; ETC; EAC; BAC.
Work scope/cost/schedule/variance analyses	Monthly Progress Report	STLs	Quarterly	At WBS Level 3/4, narrative accomplishments and issues; variance analysis reports with corrective actions, critical path, milestones status; cost and schedule earned value for current period and cumulative trends. CPI and SPI cumulative trends; ETC; EAC; BAC.
Work scope/cost/schedule	Monthly Progress Report to DOE	Project Office (B.T.)	Monthly	Same as above; summarized at WBS Level 2
Contingency	Risk Assessment	STL's	Semi-annually	At a minimum at WBS L3, assessment of cost and schedule risks with probability of occurrence of >49%.
Cost	Contingency Log	Baseline Change Control Mngr (R.J.)	As changed	Provides changes in contingency as a result of approved PCRs
Cost	BAC/EAC/Contingency status at WBS Level 2	Baseline Change Control Mngr (R.J.)	Weekly	Provides BAC and EAC by WBS Level 2; shows projected contingency use.
Funds Management	Financial Status Report	Partner laboratories compiled by Project Office	Monthly	Shows BA authorization, cumulative actual costs, and outstanding commitments
Schedule	Critical Path Analysis	Project Office (T.H.)	Monthly	Shows changes in float of activities on critical path
Schedule	Milestones Trend Analysis	Project Office (T.H.)	Monthly	Provides changes in float associated with milestones
Schedule	Milestone Status Report	Project Office (T.H.)	Monthly	Provides number of milestones completed, missed, and delinquent
Staffing	Labor Management Report	Partner laboratories, Project Office compiles	Monthly	Shows actual labor utilization vs. planned; used to control and plan labor resources buildup
Procurement	Procurement Status Report	Partner Laboratories, Project Office	As data available	WEB based system; Reflects actual awards values against planned
Baseline Management	Change Request Log	Partner Laboratories, Project Office	As changes requested for approved	WEB based system; Reflects all change requests current and history and status

APPENDIX K

MICROFRAME PROGRAM MANAGER

APPENDIX K. MICROFRAME PROGRAM MANAGER

1. INTRODUCTION

This appendix provides the framework to develop and maintain the cost and performance baseline for SNS. It is not intended to provide a tutorial for software, work packages, or cost reporting, although these facets of project control are contained in this document. Subproject files are the responsibility of, and will be developed by, project participants using this framework.

1.1 PROJECT REQUIREMENTS

MicroFrame Program Manager (MPM) has been selected as the cost module for the SNS project. The current version is 2.1; the project office will coordinate any version updates.

The SNS MPM files will consist of eleven subproject files integrated into a master project. This structure identically parallels that of the P3 schedule system. The subprojects will be grouped by technical function so that all work unique to the technical function will be contained within the subproject schedule. Each major WBS task subproject is indicated in the table below:

Subproject Schedule	WBS
Project Support	1.1.13, 1.2
Front End Systems	1.3, 1.1.1, and 1.9.3 (less 1.3.5)
Linac Systems (LANL)	1.4.1-1.4.6,1.4.9, 1.1.2, and 1.9.4
Linac Systems (JLAB)	1.4.8, 1.4.10-1.4.15 and 1.1.11
Ring Systems	1.5, 1.1.3, and 1.9.5(less 1.5.13)
Target Systems	1.6, 1.1.4 – 7, 1.1.10, and 1.9.6
Instrument Systems	1.7, 1.1.8
Conventional Facilities	1.8
Controls	1.9.1, 1.9.2, 1.9.8-1.9.10 and 1.1.9
Pre-Operations	1.10.3-1.10.6
Accelerator Systems Division	1.1.12, 1.10.1, 1.10.2, 1.4.7, 1.5.13, 1.3.5-1.3.6, 1.4.16-1.4.20

Schedule activities should be defined in a minimum of WBS Level 4 elements. Lower WBS Level may be required for sufficient schedule detail.

1.2 MPM PROJECT DEVELOPMENT

1.2.1 MPM WBS Structure

The MPM WBS structure is comprised of the WBS elements as well as the individual activity ID's from the P3 schedules. There is a one to one correspondence between MPM and P3 such that the MPM WBS hierarchy includes each activity ID in the schedule to which resources are assigned.

1.2.2 MPM BCWS Values

Resources are assigned at the activity level. The budgeted quantity (material units or labor hours) is imported into MPM from the P3 schedules or assigned directly in MPM. The resource library establishes the resources rates, and the assigned burden templates convert these individual units to escalated burdened totals by activity against which earned value is measured. These values are then summed to parent WBS elements for performance reporting.

1.2.3 MPM ACWP Values

Actual costs are imported via a flat file from the individual laboratories' accounting systems at WBS level 4 or below. FY99 actuals (and corresponding BCWS and BCWP) are assigned at WBS level 4 (either in HIST WBS elements or at the individual WBS as designated by the partner laboratories). Actual costs are imported at the Element of Cost level in MPM. These Element of Cost groupings are aggregate summations of individual resources and are listed in the table below.

Element of Cost	**EOC Code**	**Use**
N/A	A	Placeholder to allow reports by EOC to run
FY99 Data	B	Contains FY99 ACWP
Equipment	E	Contains material capital equipment costs
Overhead Costs	G	Contains laboratory overhead and/or burden costs
Historical Costs	H	FY00 data
N/A	K	Placeholder to allow reports by EOC to run
Labor	L	Contains all labor costs
Material	M	Contains all material costs
Other Direct Costs	O	Contains ODC costs
Subcontract	S	Contains all subcontract costs
Travel	T	Contains all travel costs

1.2.4 MPM BCWP Values

The BCWP values are calculated by applying the percent complete or determining the level of effort. For percent complete activities, percent complete is imported from the statused P3 schedule into MPM. MPM then multiplies this percent complete by the total value (BAC) of the activity to calculate the BCWP. If an activity is identified as level of effort, MPM assigns the current month BCWS as the BCWP. These BCWP values are summed by MPM to level 4 and above where they are compared with the ACWP imported from the accounting systems and the summary BCWS levels for performance reporting.

1.2.5 MPM ETC Values

The individual subproject files are created such that ETC is equal to the baseline. As performance measurement continues and unrecoverable variances are seen to occur, ETC can be updated with new known information for management purposes without affecting the project's reporting baseline.

1.2.6 Project Identification

In order to differentiate between projects within MPM, a subproject suffix and baseline revision number has been assigned to each subproject file. These names are assigned by the Project Office and are required to ensure baseline control. Subproject suffixes are listed below. Each month, the subprojects are consolidated into one Summary Project that is used for the Project's monthly reporting to DOE.

Subproject	Subproject Suffix
Project Support	PS
Front End Systems	FE
Linac Systems (LANL)	LN
Linac Systems (JLAB)	SL
Ring Systems	RI
Target Systems	TG
Instrument Systems	EX
Conventional Facilities	CF
Controls	CT
Pre-Operations	OP
Accelerator Systems Division	AS

Each subproject project is named by the revision of the baseline on which it is based. As a PCR is approved, a new version of the baseline is created. When the changes in the PCR are implemented into the MPM cost baseline, the MPM project is named with the revision (eg R134). A suffix is added to that name which indicates the subproject.

1.2.7 Activity Codes

Some activity codes in P3 (as defined in Appendix C) are mapped directly to MPM fields. Some of these are imported using C/SIT, some via the WBS dictionary.

P3 Code	MPM Field
1. Resource	Resource
2. Activity ID	WBS
3. Project Phase	XREF2
4. MPM Earned Value	EVM

Resource—The resource name from P3. Imported via C/SIT.

Resource Department—The resource department identifies the laboratory to which the resource is assigned. This identifies the performing organization for each resource. Imported via C/SIT after global change performed on P3 file.

WBS—Identifies the hierarchical structure in which the activity is defined.

XREF2—Identifies the project phase of the activity. These phases are defined in Appendix C. Imported with the WBS structure via access import file created from the P3 schedule.

Overtime—The overtime field holds phase of the activity at the resource level. This allows for a greater degree of granulation of the estimate. Since many resources are assigned to one activity and each activity is only permitted to own one phase, this field allows for the individual resources on the activity to be assessed separately.

EVM—The Earned Value Method (EVM) field contains the information necessary to calculate the correct BCWP. This is imported using C/SIT. All the Earned Value methods within MPM are delineated in Section 6. Currently, only three earned value methods are in use:

BCWP Entry: Used for FY99 activities to represent the setting of BCWP=BCWS=ACWP

LOE: Level of Effort used for those activities for which percent complete performance is not applicable.

Percent Complete: Used for all other activities.

MPM has a number of other Earned Value Methods possible that may be used with the project's improved adeptness with the product.

Performing Department—The performing department field in MPM is assigned at WBS L4.This identifies the subproject actually performing the work and is distinct from the Responsible Department.

Performing Laboratory	Identifier
Oak Ridge	ORNL
Conventional AECM	AECM
Argonne National Lab	ANL
Brookhaven National Lab	BNL
Los Alamos National Lab	LANL
Thomas Jefferson Accelerator Facility	JLAB
Lawrence Berkeley National Lab	LBNL

Responsible Department—The responsible department field in MPM is populated at WBS L4 and indicates that lab responsible for the WBS element

Responsible Laboratory	Identifier
Oak Ridge	ORNL
Conventional AECM	AECM
Argonne National Lab	ANL
Brookhaven National Lab	BNL
Los Alamos National Lab	LANL
Thomas Jefferson Accelerator Facility	JLAB
Lawrence Berkeley National Lab	LBNL

Resource Department—The resource department field in MPM is populated by a global change that maps the prefix for each resource to the lab identifiers as listed below. The one exception to this is that resources containing DB (Davis Bacon), CM (construction) and AE (Architect-Engineer) are all mapped to the AECM department. This identifies the subproject actually performing the work and is distinct from the Responsible Department This global change is accomplished by the project office prior to importing the data from P3 into MPM.

Resource Department	Identifier
Oak Ridge	ORNL
Conventional AECM	AECM
Argonne National Lab	ANL
Brookhaven National Lab	BNL
Los Alamos National Lab	LANL
Thomas Jefferson Accelerator Facility	JLAB
Lawrence Berkeley National Lab	LBNL

XREF1—Allows for consolidation by Division as well as laboratory

XREF1	Identifier
Oak Ridge	ORNL
Conventional AECM	AECM
Argonne National Lab	ANL
Brookhaven National Lab	BNL
Los Alamos National Lab	LANL
Thomas Jefferson Accelerator Facility	JLAB
Lawrence Berkeley National Lab	LBNL
Accelerator Systems Division	ASD
Experimental Facilities Division	XFD
Site Operations Division	SOD

1.2.8 Calendar

A general calendar is established in MPM. However, since the resources were imported in from P3, the assignment of the budgeted quantity for each resource is correct based upon the individual lab calendar that is associated with each subproject P3 schedule.

1.2.9 Resource Codes

Resource codes should be assigned to all activities on which earned value is calculated. The resources should be those used when originally estimating the effort and are unique to each laboratory. Effort resources should be loaded in hours, material procurements, travel and supplies and expenses (S&E) should be loaded in units. Resource names are defined by the subproject. However, they must contain the two-digit lab identifier that is then used for identification of the performing department. Each resource is assigned an Element of Cost field, rate and burden template within MPM. Resources with different burden treatments should be identified as distinct resources to ensure accurate calculation of their burdened and overheaded values. DOE escalation rates are applied in the rate library. The resources and rate library are stored in MPM.

1.2.10 MPM Cost Elements

These identify different levels of costs and are defined below.

Hours: Individual hours for the resource
Equivalent Person Months: Not used
Prime: Individual hours times the resource rate
Rate: Individual resource rate identified by the laboratory
Overhead: The overhead applied at the individual laboratory
Total Burdened: The sum of Prime plus Overhead
Gen and Admin: Escalation
Total Cost: The sum of Gen and Admin and Total Burdened
Cost of Money: Not used
Total Dollars: Same as Total Cost
Fee: Commitments
Total Price: Not used

1.2.11 Monthly Reporting Process

The Project Office consolidates each of the statused and updated MPM subproject files each month into a master summary project used for project reporting. The individual subprojects are updated with ACWP and BCWP and then merged into a summary project. These individual subproject files are then placed on the server for use by the subproject's individual reporting. The schedule for this process is posted three months in advance on the Cost and Schedule Integration Topics Web Site.

ACWP—Actual costs are submitted to the Project Office in a flat file format directly from the individual subproject's accounting systems. These individual files are consolidated and then imported into the individual subprojects to ensure all costs (those from both responsible and performing organizations) are accurately mapped to the appropriate WBS elements. This summary file is also posted on the server for use by the subprojects.

BCWP—Percent complete by activity is exported monthly from the statused detailed schedules. This is then applied to the BAC of each individual activity and the appropriate BCWP is calculated.

1.2.12 File Transfer and Maintenance

The following file structure on the SNS server will be used to manage the project's cost baseline. Each participating laboratory has a unique subdirectory on the server where a completed subproject file may be placed. This file will be copied into another subdirectory where the % complete and ACWP data will be imported. Once the subproject files are updated, they are placed in another area from which the new project can be downloaded by the laboratory.

The main directory on the SNS server used for schedule merging is Proj_Cont/MPM.

The subdirectory for uploading schedules is the Upload_MPM_Files

The folders within the Upload_MPM_Files subdirectory are:

TARGET
FRONT END
RING
LINAC
CONVENTIONAL
CONTROLS
PRE_OPS
PROJECT MANAGEMENT
INSTRUMENTS
JLAB
ASD

A copy of the updated Summary Project ready for download, will be placed in the SNS CPR folder under the current month. Individual projects will be placed in the Download_MPM_Files directory in the following folders:

DLTARGET
DLFRONT END
DLRING
DLLINAC
DLCONVENTIONAL
DLCONTROLS
DLPRE_OPS
DLPROJECT MANAGEMENT
DLINSTRUMENTS
DLJLAB
DLASD

1.2.13 Updating the Cost Baseline

The MPM cost baseline is maintained at the Project Office and is updated only with approved Project Change Requests. In order to update the baseline, a resource loaded P3 schedule or a revised MPM supbroject file are required as attachments to the PCR. If an MPM project is attached, it should be named using the two digit subproject identifier and the last three digits of the PCR ID. Once the file has

been checked, accepted as the cost baseline and contingency adjusted, this file will be renamed with the appropriate revision number and posted on the server in the appropriate subproject folder. A full set of baseline files is created for each PCR. These are stored under folders that indicate the revision number in the Baseline folder within SNS_MPM.

1.2.14 MPM Globals

MPM global files represent the costing tools of the project. These include burden templates, resource tables, resource rates, escalation rates and elements of costs. The Project Office updates these and the most current globals are those to be used by the subprojects. Globals may be copied by the individual subproject to perform cost "What if" analyses. However, the official set of global files is that published by the project office. The escalation rates used are those published by DOE. Rate , burden and escalation changes are effected via a PCR.

APPENDIX L

RISK ASSESSMENT TEMPLATE

APPENDIX L. RISK ASSESSMENT TEMPLATE

1. INTRODUCTION

This appendix provides the method by which to complete the Risk Assessment template.

a) The risk assessment will be done at the reporting level. [Column A]

b) The BAC is the Baseline Budget at Completion as per the MPM baseline files utilized for the specified reporting period. [Column B]. For each concern listed, the value of this concern in the baseline must be stated. That will enable the project office to calculate the value of the remaining work that has not been specified and assess the "generic" contingency only on that amount. If this is not done, the risk assessment will be overstated.

c) Spares should not be included. They are covered in a separate document and will be added to the assessment as required by the Project Office.

d) If the specific risk identified is related to a commitment, indicate that by including "commitment" in the description of the risk.

e) Installation (if it is applicable to the subproject) should be specifically called out (at a minimum at level 3) even if the probability/likelihood assigned does not exceed 50%.

f) Each WBS level 3 must be explicitly reviewed. If there are no risk items in a WBS level 3, please state so on the table. Blank fields do not imply negative responses.

g) Unrecoverable cumulative cost variances should be identified and the cause described. [Column C]

h) PCRs currently in the system should be identified (by PCR number) and quantified. PCRs in the system as a result of the unrecoverable cost variances should be clearly identified to preclude double counting. [Column D]

i) Other potential changes should be identified with a description [Column A], an estimated amount [Column E], and an associated probability of occurrence [Column G]. *NOTE: Potential changes that have a probability of occurrence $\geq$ 50% must be included. Those with a lower likelihood may also be included as long as they do not add clutter and obscure the key issues.*

j) The impact of changes on the IPS early finish schedule, the technical performance of the machine, or both should be stated. The fact that they have a cost impact is self-evident. If there is no impact other than cost, "None" should be entered in that field. [Column H]

k) If an early finish schedule impact is anticipated, then the approximate number of days of that impact and the IPS activity description or activity ID should be listed. In lieu of the IPS Activity ID, the detailed schedule activity ID can be entered. [Column I] Only the activity affected needs to be listed. Successor activities can be identified from the schedule itself. It will be assumed that the probability of the impact is equal to the probability of occurrence of the change. [Column G]

l) For all possible increases to the cost baseline (including PCRs already in the system and not approved**)** a mitigation strategy that offers a compensating reduction in cost or scope to recover the estimated amount must be provided. [Column J]

m) The risk expiration date must be provided. [Column K]

n) Columns L through N give a representation of the potential contingency needs according to the various probabilities.

o) The balance of the remaining work (that not specifically identified in the table) will be assessed in the following manner. If these risk factors are not appropriate for your remaining work, please provide the risk factor(s) to use along with the justification.

p) All commitments and awarded but phase funded contracts will be assigned a 5% contingency reservation.

q) All other remaining work will be analyzed to determine if a 5% or 10% contingency reservation is appropriate.

- EXAMPLE ONLY -

A	B	C	D	E	F	G	H	I	J	K	L	M	N
WBS	BAC (Rev #)	Cum cost variance (if unrecoverable)	PCR's in the system	Other Potential Changes	Total Changes	Probability of occurance	Impact on:IPS Schedule, Technical Performance, Both or None	Early Finish schedule impact (#days) if risk materializes	Mitigation Strategy	Risk expiration date	100% EAC	>75% EAC	> 50% EAC
1.3 Accelerator Front End Facilities	11,839,777	30,000	150,000	110,000	170,500						11,939,777	11,972,852	11,987,852
1.03.01 Ion Source and LEBT	**2,480,376**	**30,000**	**100,000**	**70,000**	**142,500**						**100,000**	**116,875**	**126,875**
1. Vendor quote higher than estimate (PCR FE-02-999)	200,000		100,000		100,000	100%	None		Save compensating $ on vge procurement	Jul-02	100,000	100,000	100,000
2. Failure of xyz	100.000			40.000	20.000	50%	None		Shorten testing to compensate for labor costs.	Oct-02	0	0	10,000
3. Increase in cost of abc	80,000			30,000	22,500	75%	None		Use lower grade material.	Dec-02	0	16,875	16,875
4. Increase in laboratory overhead rates		30,000			30,000	100%			Terminate Project Management one month early.	Dec-02	30,000	30,000	30,000
5. Delay in shipping due to teamster strike						50%	Schedule	+15 days on Installation and Checkout. IPS FEIN	Pay extra and ship by air.	Oct-02	0	0	0
1.03.02 RFQ	**2,785,173**		**50,000**	**20,000**	**10,000**						**0**	**0**	**5,000**
1. Replacement of qya	100.000			20.000	10.000	50%	Performance		Do not upgrade.	Jul-02	0	0	5.000
2. Additional labor for 24x7 test	0		$50,000			100%			Cancel or shorten test.	Jul-02	0	0	0
1.03.03 MEBT	**2,552,148**		**0**	**20,000**	**18,000**	**0**					**0**	**16,200**	**16,200**
1. Repair of sdf might be required	10,000			$20,000	18,000	90%	Schedule	+10 days on FE Beam available to DTL, IPS FE120	Don't install full hot test stand to compensate for cost.	Dec-02	0	16,200	16,200
1.03.04 Tehcnical Support	**3,532,080**		**0**	**0**	**0**	**0**		**0**			**0**	**0**	**0**